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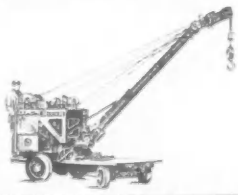

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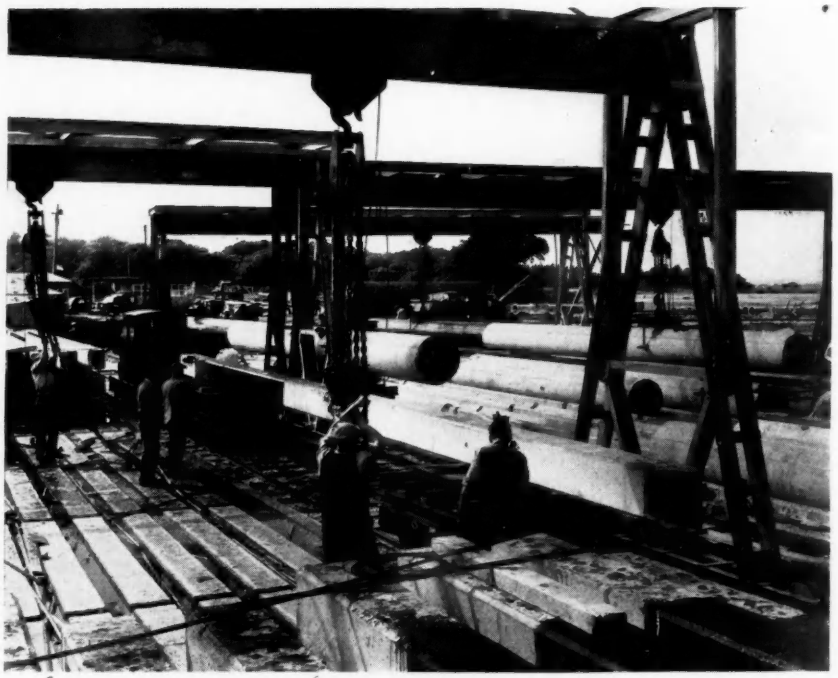

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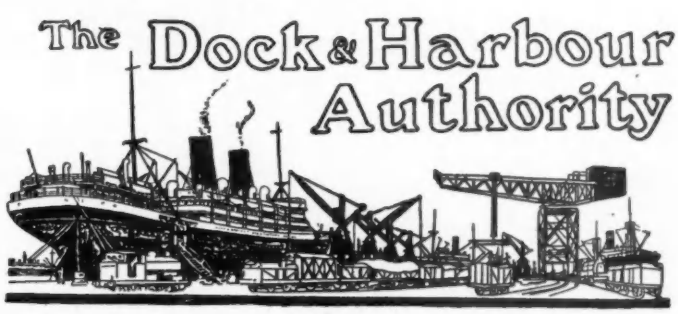

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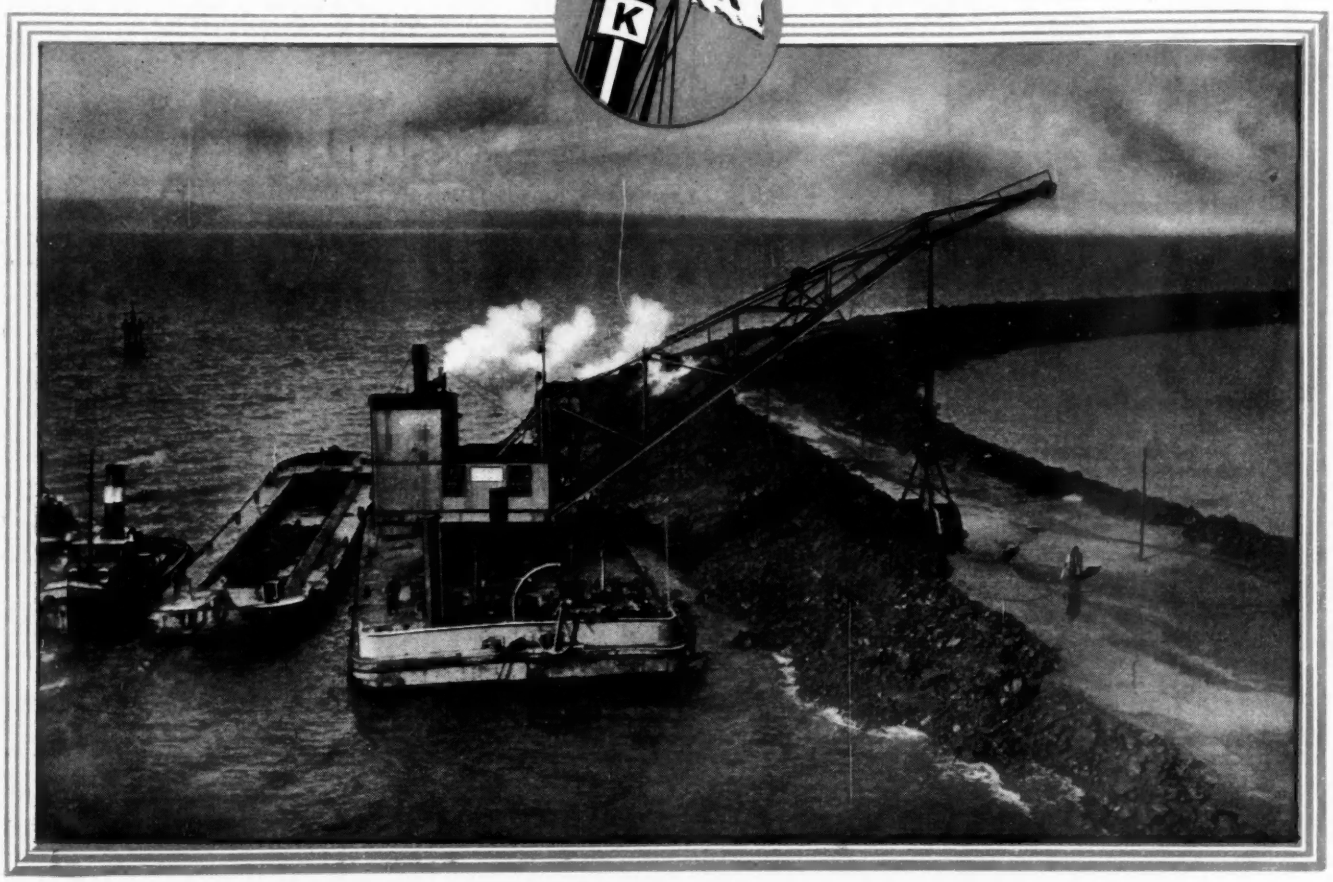

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The Dock and Harbour Authority

No. 361. Vol. XXXI NOVEMBER, 1950 Monthly 1s. 6d

Editorial Comments

THE RIVER ST. LAWRENCE.

As the St. Lawrence River is not naturally navigable throughout its entire length, many and varied schemes for its improvement and development have been carried out, and since the last decade of the nineteenth century, the project for a St. Lawrence Seaway has been periodically before the public.

In the March and April, 1947, issues of this Journal, a paper by Mr. Kerry entitled "Ice Blockade of Canadian Ports" was reproduced, which he had previously presented at the Annual General Meeting of the Engineering Institute of Canada. In that paper Mr. Kerry reviewed the data which had been collected at various times, by several National Scientific Institutes and other eminent investigators, together with the views as to the feasibility of an ice free channel which were expressed in the course of their studies, and as a result, he drew the conclusion that the Great Lakes are large scale natural accumulators of heat energy, in which the temperature of the mass of their water is never as low as freezing point, and that further research in the Great Lakes basin and St. Lawrence valley as to evaporation, surface radiation, and convection, was highly desirable, with a view to utilizing the warm water in the Great Lakes to keep the river free from ice to a point east of Quebec.

In a subsequent article, the first instalment of which is published in this issue, Mr. Kerry takes his studies some stages further, by considering ice conditions in the whole St. Lawrence Waterway from Lake Ontario to the estuary and open sea; formulating proposals in regard to the erection of barrages, intercepting and diversion dams, together with the formation of a deep-water channel to convey all the necessary warm water, at a suitable current speed, from Lake Ontario to the Isle aux Coudres, and so overcome freezing.

These proposals are necessarily closely linked with the St. Lawrence Seaway Project, and we are therefore publishing another article, giving a summary of the past history and salient points together with the engineering features of the Seaway project, which will enable readers to examine the proposals in full.

Apart from the economic aspects of the Seaway project, there appear to be two physical considerations which call for further study before a scheme of such magnitude is put in hand. These are the depth of the channels and locks, and also the problem of making the seaway ice free for the whole year.

As to the latter, Mr. Kerry's views, expressed in his first paper, coupled with the schemes he now puts forward, appear to be worthy of further study by an inter-government scientific department, as he recommends.

Multiple political control of a river produces anomalies which are most difficult to rectify when the river flows from one State into another, and the history of the St. Lawrence is no exception. Other outstanding examples are the Danube and the Nile, and, in both cases, opposing interests, on the whole, were successfully resolved.

Yet another anomaly of dual possession, is illustrated in the Great Lakes and St. Lawrence system, by the fact that a vanished outlet stream from Lake Michigan (formed in a past geological age, when the present outlet of the Great Lakes was blocked by ice) has since been reconstructed, so that to-day, a large volume of water passes from Lake Michigan—which is wholly in U.S.A. territory—to the Mississippi. The question is how far this diversion of water has had an adverse effect upon water levels in the St. Lawrence, as far seaward as Montreal and Three Rivers.

No doubt in due course the United States and Canada will come to complete agreement upon all the aspects, physical and economic, involved in the great project of the St. Lawrence Seaway, so that this important waterway, which nature has placed at the disposal of the two countries, can serve the interests of both populations.

NEW DEVELOPMENTS IN CARGO SHIPS AND VEHICLE HANDLING.

The normal type of tramp ship, with its series of deep holds, with either no 'tween decks or, at most, only one tier, which is well suited for the carriage of bulk cargoes of coal, grain, chemicals, timber, ores, etc., is not so suitable for carrying cargoes of manufactured goods, so that if a bulk cargo is not available, only parcels which can be stacked one upon the other can be stowed economically in the holds.

There is therefore, a need for a new type of cargo ship, capable of carrying in its holds variations of either bulk or parcel goods, so it is not surprising that attention has been directed towards some ready means of overcoming the limitations of existing vessels.

The "Mezzo" Deck-Grain Division, described elsewhere in this issue, is a new British invention, which converts, at moderate cost, an ordinary tramp or general cargo steamship into a dual-purpose vessel, equally effective for carriage of bulk dry cargoes, packed goods, or uncased motor cars and tractors. In new construction, this system would take the place of the usual steel centre-line division, conforming with the regulations for grain shipment, but removable with decks and pillars, as other circumstances require.

A further noteworthy development concerns the handling of vehicles. Before the last war, a great proportion of British motor cars for export were boxed, but due to shortage of timber, this practice has been largely discontinued. In Britain's changing export trade, the shipment of vehicles has taken a leading place, and the need for a speedy and safe means of loading them uncrated is consequently of great importance.

Speed is an essential consideration in cargo handling to-day, and time can no longer be given for the care and supervision which was required when the older methods were used. The Furness Car-Lifting Gear, also described in this issue, is therefore likely to be of considerable interest to stevedores and port authorities.

Editorial Comments—continued

THE DEVELOPMENT OF THE TEES.

In spite of the handicaps imposed by shortages of materials and manpower, the Tees Conservancy Commission, with commendable enterprise, have completed the first stage of their development scheme. On the 6th October last, Mr. Barnes, Minister of Transport, officially opened the first of two deep-water oil berths at Teesport on the south bank of the Tees, and the Marquis of Zetland, Lord Lieutenant of the North Riding, opened the new Tees Dock Road, 2½ miles in length, which gives unrestricted access to the new berths and dock site. The cost of the road and berths was £750,000, and accommodation and handling facilities have now been provided for the largest oil tankers afloat.

The Commissioners are to be congratulated on their initiative, especially as the new installations will greatly assist the rapidly expanding industries in the area. For many years past, Tees-side has been almost exclusively known for its production of iron and steel, but during the post-war years many new enterprises have been put in hand, notably the new works of Imperial Chemical Industries at Wilton, and the extensions of Messrs. Dorman Long & Co., Ltd. ,at Lackenly, besides other ancillary works.

It is unfortunate that owing to economic limitation of capital expenditure, other improvement schemes must be held in abeyance. Also, the recent decision of the Docks and Inland Waterways Executive to recommend the transfer of the port undertakings of the Tees and The Hartlepools to the British Transport Commission is causing uncertainty.

About a year ago the Executive invited local interests to give their views on three alternative schemes for unification of the ports in that area, and it now appears that, of these three alternatives, the Executive proposes that the Transport Commission, who already own the docks system of The Hartlepools and Middlesbrough Dock, should become owners of all port facilities and public wharves, but leaving day-to-day management in the hands of a small nominated local board. There is no question that this particular alternative is viewed with disfavour by some of the interests concerned, and preference has been expressed for the creation of a local port authority to which all assets would be transferred together with all powers and obligations. It is obvious, however, that there would be many financial difficulties to overcome in setting up such a body.

We understand that, so far, no final decision has been made, and it is to be hoped that further careful consideration will be given to the recommendations of the local bodies and shipping interests who, undoubtedly, are best placed to advise on a subject of such importance to the area they serve.

LABOUR PROBLEMS AT NORTH EUROPEAN PORTS.

On page 209 we print an article which recently appeared in *Lloyds List* dealing with the present situation in the Port of Antwerp. Among other things it sets out what the Belgian Labour Unions are claiming for port workers and compares wages and costs at Antwerp with those at other North European Ports. Traffic, too, is similarly analysed, and the figures quoted show how serious is the competition of Rotterdam.

One of Antwerp's most alarming problems is the incidence of strikes and unemployment among port labour, and there is a body of opinion which argues that the introduction, about three years ago, of the so-called Social Security Scheme for port labourers has brought grave consequences. In 1945 Antwerp became an important military port with a labour force based on the " artificial " needs of that time. It may be that part, at least, of Antwerp's troubles is due in the first place to difficulty in adjusting that labour force to the commercial requirements of to-day, and secondly, to increasingly keen foreign competition.

The decasualisation of the British port worker during the late war, brought with it some uniformity of pay and working conditions, and consequently did something to minimise causes of discontent. It is still, of course, a controversial scheme, and the security which it gives to port workers can obviously lead to abuses. None the less, experience is showing that the scheme can be made to operate successfully.

The psychology of the docker, the stevedore, the labourer in the sophisticated ports of the world is undoubtedly unique. He is a man conditioned by an environment peculiar in that it gives the worker an unusual freedom. Loading and unloading a huge variety of goods in all kinds of weather, from every conceivable type of ship berthed at different premises, each differently constructed and differently equipped, is work which cannot be done by rule of thumb, and which is difficult to discipline by either Employer or Union Official. In such circumstances pay, working conditions, customs and practices, must vary over a wide range, and the port worker who wants for himself the best of all the privileges and conditions which exist in the industry as a whole, is unfortunately, far too often the man who supports unconstitutional action.

INTEGRATION OF BRITISH TRANSPORT.

A further statement upon the objectives and methods of integrating services by inland waterways with those by rail and road was made by the British Transport Commission early last month. This was followed by a debate in the House of Commons, during which Members from both sides of the House accused the Government of complacency, and so provided yet another occasion for the kind of ministerial apologia that has become common form in the reviews of nationalised industry. The Minister of Transport rejected the case for a subsidy, even towards the cost of maintaining strategic lines of communication, not on the demerits of the case, but because this was no time for adding directly to the taxpayers' burden. Whilst, of course, it was railway lines which were being chiefly considered, the conclusion cannot be escaped that drastic action cannot long be delayed to deal with the continuing deficit on canal operation. If the losses cannot be condoned on the grounds of the strategic value of certain canals for transport in an emergency, the time has surely come to transfer canals of little commercial utility to other authorities, such as Catchment Boards and Conservancy Commissions, to charge some other account with the losses on the Caledonian and Crinan canals, and to plan for increased efficiency upon the remainder.

A further statement of policy would therefore be welcome, if this policy would eliminate the deficits on operating account, both in carrying activities and otherwise. Unfortunately, the new statement which will be found on a following page contains little except a survey of the traffics which are especially suitable for inland water transport. The proposal to transfer delivery vehicles to the Road Haulage Executive cannot be expected to show any significant economy. Indeed, this transfer may very well prove to be a further obstacle to efficient operation, as the Road Haulage Executive might very reasonably give priority in allocation of vehicles to their own long distance traffic. This would further delay loading and unloading of canal boats, of which the demurrage costs are inevitably high, due to the resident crew. Furthermore, competition from road transport for the traffic at present carried by canal, is not likely to be lessened in intensity by this change. It will be remembered that the loss of the Stourport coal traffic to the canals did not, apparently, follow any decision toward " integration," but resulted from a lower quoted price from one of the other Executives, and this is the nature of the threat to carriage by canal, for so long as a substantial proportion of the traffic is carried in narrow boats.

This statement about the nature of traffic which might be carried in greater quantities by water, must surely be followed by another in which long-term plans are announced to attract new traffic and to carry it economically. Mr. Callaghan's vigorous rebuttal during the debate of the allegation that individual Executives and Regional Offices are suffering from frustrating and strangulating control by the Commission headquarters, leaves the way clear for the Docks and Inland Waterways Executive. If this Executive now propounds a forthright plan, which includes enlargement of certain narrow canals to permit the passage of estuarial craft, it will have the whole-hearted support of expert opinion. Such a policy naturally follows from the first point in the latest statement; if its immediate implementation is denied by higher authority, if the current economic situation does not yet permit the capital expenditure, the Executive would at least have made its mark in history, as responsible for advocating a policy courageously and intelligently conceived.

The Saint Lawrence Seaway

A Survey of Past and Present Developments

By H. F. CORNICK, M.C., A.M.I.C.E.

PHYSICAL CHARACTERISTICS OF THE RIVER

THE River St. Lawrence, if the five fresh water lakes, Superior, Michigan, Huron, Erie and Ontario are included, is the second largest river in North America, and forms one of the great river systems of the World. Its catchment area is about 480,000 square miles and its length from the source of the River St. Louis, which rises in the mountains west of Lake Superior, to Cape Gaspé where the St. Lawrence enters the Gulf of that name, is some 2,300 miles, but it is from the foot of Lake Ontario only that the name St. Lawrence is applied to the river. The Great Lakes and River down to the point where the 45th parallel crosses the latter, some miles above Montreal, forms the boundary between the state of New York and the province of Ontario; from thence to the sea the St. Lawrence River is entirely Canadian.

Despite its large and uniform flow, the St. Lawrence is not naturally a navigable river, for its character varies with the geological formations through which it passes. From Kingston, at the mouth of the Rideau River, to Brockville, some 20 miles above the Galop Rapids, it flows over Archean rock formations and the river is broken by protrusions of granite and gneiss into innumerable islands of picturesque repute. From Brockville to Montreal the river flows through flat-bedded Cambrian-Silurian limestones of the Paleozoic Period, with rapids at several places. From Montreal to Three Rivers the course is through an alluvial plain overlying the limestone strata where, at one point, the river expands into Lake St. Peter. Below Three Rivers the river banks gradually grow higher until, after passing Quebec through a great cleft in slate rocks of Cambrian age, the stream widens, washing the foot of the Laurentian mountains on the north shore, while the south shore is formed by a more moderately hilly country which terminates in a range of mountains reaching the Gaspé peninsular.

The main natural barriers to navigation on the present Great Lakes—St. Lawrence waterway are the rapids and shallow depths in the St. Marys River (between Lakes Superior and Huron); the shallow stretches in the St. Clair River, Lake St. Clair and Detroit River (between Lakes Huron and Erie); the Niagara Falls and rapids in the Niagara River (between Lakes Ontario and Erie); and the rapids in the St. Lawrence River (between Prescott and Montreal).

Locks in the St. Marys River and in the Welland Canal, which connects Lakes Erie and Ontario and bypasses the Niagara Falls, have been enlarged to enable them to carry bigger ships, with the result that the shallow channels between Lakes Superior and Erie, together with the 119-mile stretch of the Upper St. Lawrence between Prescott and Montreal, are the only remaining barriers to such vessels. The canals that have been built to overcome the Galop and Long Sault Rapids between Prescott and Cornwall, the Soulanges Rapids between Lake St. Francis and Lake St. Louis, and the Lachine Rapids between Lake St. Louis and Montreal, are navigable only by ships of less than a 14-ft. draft.

The aims of the proposed seaway project are the deepening of the Upper Lakes channels, the replacement of the St. Lawrence canals by one capable of passing larger vessels and, at the same time the development of the larger power potential of the International Section of the St. Lawrence River.

DEVELOPMENTS AND IMPROVEMENTS

The thoroughfare of the Great Lakes begins at the extremities of Lakes Superior and Michigan and runs down to the eastern end of Lake Erie. Until the nineties Canadian development of Manitoba had not been appreciable, on the other hand, in the United States, development of the middle western and north western regions was already far advanced, and it was accordingly the United States Government that undertook practically all the deepening and widening in the connecting channels of the upper lakes, required to accommodate the vessels bringing large quantities of grain and minerals down to the Lake Erie ports.

The waterway of the upper lakes terminates at the western end of Lake Erie and it is there that costly and competitive navigation and railway improvements begins.

From Buffalo the old Erie Barge canal, with 7 feet of water and locks of 110 feet in length was constructed eastward to meet the Hudson river at Albany, and thus to furnish water communication with New York. This project met with serious competition from the railways in New York State and passing through many vicissitudes at one period became virtually obsolescent.

The rival Canadian outlet from the upper lakes commenced with the Welland canal across the Niagara peninsular, to overcome the difference in level of 326 feet between Lake Erie and Lake Ontario. This canal, constructed by the Canadian Government, and opened in 1887, had a channel 14 feet in depth and locks of sufficient size to permit the passage of vessels of a length of 255 feet and a capacity of 2,500 tons.

Then a series of canals around the rapids in the St. Lawrence with a difference in level of 226 feet in all, were constructed and later enlarged so that by 1900 they were sufficiently completed to permit the opening of a continuous system of navigation with a 14-ft. depth of channel from the upper lakes to Montreal. At this time a comprehensive scheme of development of this harbour and port was put in hand, one of the major items of importance being the installation of grain elevators and loading galleries, which was brought into service in 1908 and by means of which grain could be loaded into ocean vessels lying at their berths in the Port.

A channel 30 feet in depth in the St. Lawrence below Montreal had already been opened for navigation by ocean going vessels in 1906, and this work, in conjunction with the harbour and port improvements, established Montreal as an important ocean terminal port.

INCEPTION OF THE DEEP WATERWAY

The first vigorous demands for the construction of a deep water communication between the upper lakes and the Atlantic arose in the early nineties, as one phase of a widespread agitation for improved inland waterways. As a result of these demands the Canadian and United States Governments in 1895 appointed the first commission of enquiry, to report upon the economic aspects and merits of the proposals and to indicate possible routes, but no action was taken upon the reports, which were in due course submitted.

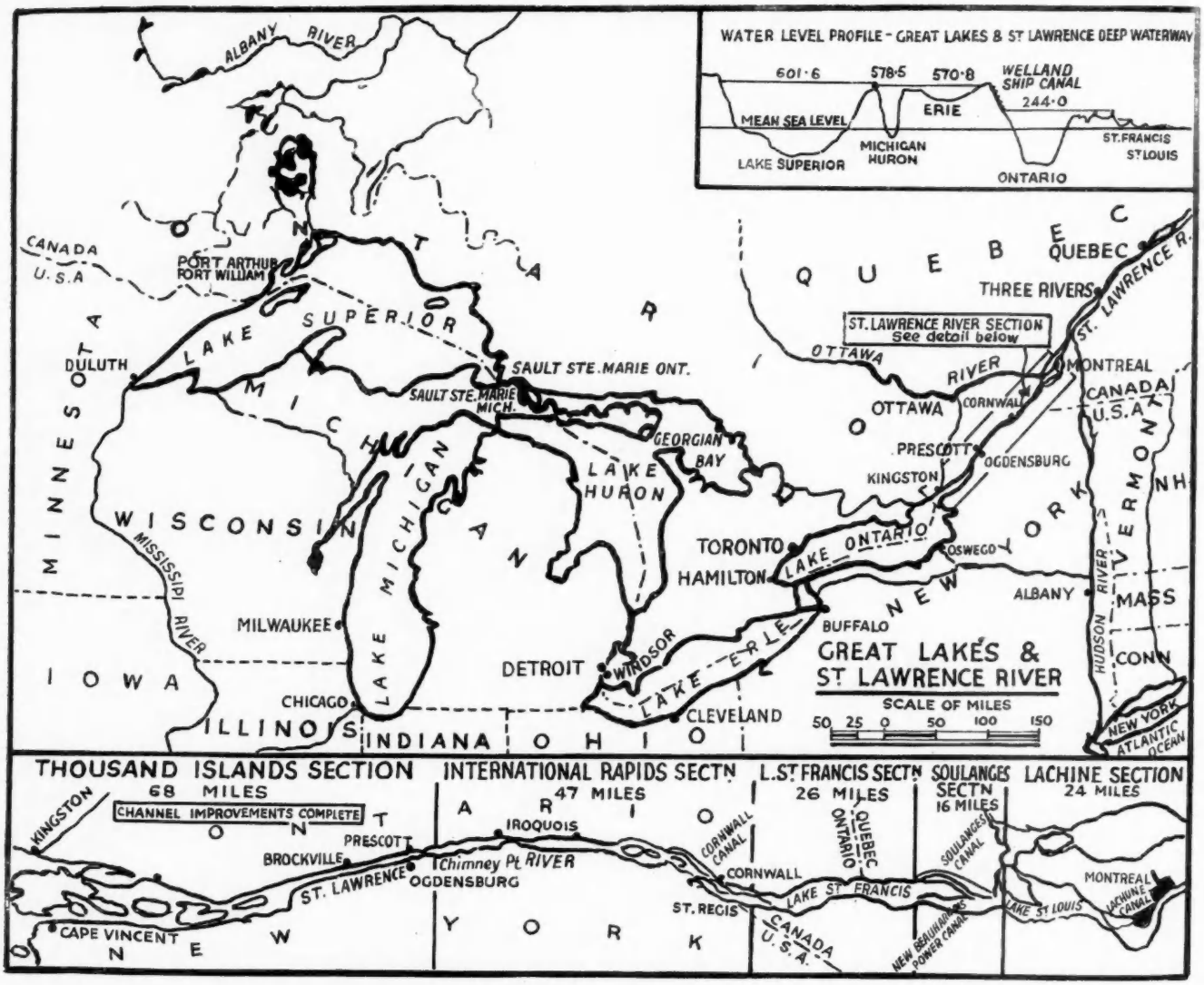
However, the deep water movement stimulated a new interest in the State of New York in the Erie Canal and its possibilities, for it soon appeared that the 14-ft. navigation channel from the upper lakes to Montreal was having a detrimental effect upon the trade of New York. As a consequence a new Erie Canal of dimensions comparable with the St. Lawrence waterway was constructed by the people of New York State, upon the general line of the old Erie route.

The turn of the century brought a rapid expansion of the settlement of the prairie lands of the Canadian west, and with it a great increase in the production and exportation of grain. To meet the needs of an additional outlet for this grain and at the same time to counter the threat to the trade of the St. Lawrence, of the projected New York barge canal, the Canadian Government in concert with the Grand Trunk Railway Company of Eastern Canada, determined, in 1903, to construct a new line of railway from Winnipeg by the shortest practicable route direct to the Port of Quebec, for members indicated their belief that it would in consequence succeed in carrying grain eastwards for export at less than the cost of all-water shipment down the Great Lakes and the St. Lawrence River to a St. Lawrence port. Between 1908 and 1913

The Saint Lawrence Seaway—continued

other railways across the prairies, together with branches and extensions, were planned and built with Government support.

Even while aid was being extended to the two great railway systems, however, the Dominion Government was also turning its attention to the cheapening and improvement of inland water transportation. In 1903 it removed all tolls upon the 14-ft. systems of the Welland and St. Lawrence canals and in 1904 it authorised detailed surveys for the canalization of the French and Ottawa rivers route (the so-called Georgian Bay canal) upon such a scale that would permit the upper lake freighters of the largest size to canal. No careful economic survey appears to have been made as to the necessity of the 25-ft. deep (eventually 30 feet) ship canal, for the Government appears to have overlooked the fact that the 14-ft. system of navigation of the upper St. Lawrence and Welland canals had been completed only within the last three or four years and was already showing evidence of definitely effective commercial operation and technical superiority over the barge canal, which the State of New York had elected to construct. Moreover, at the time of the decision, the view appears to have been held that it would never be practicable to construct new canals of the same



proceed by continuous voyage from lakeland ports through Lake Huron to the St. Lawrence at Montreal.

Acting on his own initiative, a year or two later, the Chief Engineer of the Welland Canal carried out surveys for a new canal of much larger dimensions upon the same general route.

Strong support was given to both of these projects by both the Government and the opposition, and the former asserted its intention to proceed with either or even both of the schemes. In 1911 it was revealed that the Welland surveys had reached the point of a thoroughly practicable route and a recently elected new Government, in view of the steady progress towards completion of the New York State barge canal, together with the apparent inefficiency of the National Transcontinental railway, hastily decided in 1912 to undertake the immediate construction of a new Welland scale upon the upper St. Lawrence to continue the deep water navigation of the Great Lakes beyond the foot of Lake Ontario and down to Montreal.

It has been pertinently asked why the Canadian Government preferred the Welland Canal project to a scheme for the construction of a canal of the same scale from Lake Huron by the Ottawa River all the way to Montreal. There are, it is understood, several good technical and economic arguments against the adoption of the Ottawa River route, but the most important consideration apart from any political expediencies, appears to have been, that whereas the Ottawa River scheme would have taken some ten years to complete, the Welland Ship Canal could be opened for navigation in four or five years.

Construction of the Welland project was commenced in 1913, and after being necessarily retarded during the early years of the

The Saint Lawrence Seaway—continued

first World War, was suspended during 1917 and 1918. Resumed in 1919, it was finally completed in 1932.

Just prior to that War a joint Standing International Waterways Commission had been established, to study questions of mutual interest to Canada and the United States. Subsequently it assumed permanent status as the International Joint Commission set up by the Boundary Waters Treaty of 1909.

The question of a deep waterway in the St. Lawrence was discussed by the two Governments in 1914, but was dropped because of the War.

POWER PROJECTS

It is desirable, at this juncture, to refer to another source of interest in the upper St. Lawrence—the use of the flow and differences in level of its rapids for the generation of electric power. One of the first power stations was built by an act of the New York Legislature in 1896, at Massena, N.Y., upon a canal from the head of the South Sault Channel, discharging into the Grass River. On the Canadian side of the St. Lawrence another power company commenced producing power in 1900, using a contractors canal formed in connection with the 14-ft. Cornwall navigation canal constructed between 1893 and 1897.

Thereafter several private companies sought and obtained, from time to time, from the Canadian and United States Governments, powers to exploit the great natural sources of power in the Upper St. Lawrence, with canal dams and power stations at such places as Long Sault, Cedars Rapids, Valleyfield, Beauharnois, all of which were conceived and constructed without reference to any desirability of combining power projects with possible deep water navigation requirements. The only exception appears to be that a clause in a Beauharnois Power Bill of 1932 stated that the canal then being constructed or to be constructed, joining Beauharnois and Valleyfield, should thereafter be under the legislative jurisdiction of the Canadian Government and be available for navigation for vessels of such size and draft as might use the New Welland Canal upon its completion.

INTERNATIONAL COMMISSIONS AND TREATIES

From 1914, when the inter-governmental discussions were dropped, a number of factors strengthened the movement to construct a deep waterway in the St. Lawrence. New industries established about this time began to feel the need of cheaper transport to competitive markets, and the opening of the Panama Canal diminished the advantages of the Middle West in terms of transportation costs relative to the Atlantic and Pacific sea boards. Congestion on the railways and the general increase in trade from the Great Lakes economic area, underlined the need for cheap water transport, and the increased need for power during the first World War became a significant aspect of the seaway project.

During the war, much independent development work on dredging and canal improvement of the St. Lawrence was undertaken by both Canada and the United States, and the desirability of future co-ordination and planning becoming apparent. In the immediate post-war years, inter-governmental commissions studied the engineering and economic aspects of the deep waterway, and in 1921, the International Joint Commission undertook a thorough study of the seaway project. Canadian and American engineers were commissioned to report on the technical problems, and their report established the feasibility of the project from the engineering standpoint. After extensive hearings, the International Joint Commission reported favourably on the seaway from an economic point of view.

A joint Board of Engineers of six members was appointed in 1924 to review all previous studies on the seaway and to present a report to the Canadian and United States Governments. The report was presented in 1926 and confirmed the feasibility of the seaway and made estimates of costs. At the same time, two advisory committees were set up to consider the purely national aspects of the proposals. The American St. Lawrence Commission issued its report strongly favouring the proposed Deep Waterway. The Canadian Advisory Committee reporting to the Prime Minister of Canada supported the project, suggested continued negotiations with the United States, and outlined a possible basis for a division of costs between the two countries. Final agreement between Canada and the United States was finally reached, and a Treaty was eventually signed in 1932.

Discussion in the United States regarding ratification of the Treaty lasted for two years, during which time Senate Committees and special commissions debated the merits of the project. There was strong opposition from representatives of various groups in the United States who feared they would suffer financially as a result of the scheme. Senators from Mississippi riparian States, made a counter proposal for deepening the Chicago drainage canal which would link Lake Michigan and the Mississippi and thus make at least part of the Great Lakes area tributary to the Gulf ports. Spokesmen from the Atlantic seaboard stated that the seaway would deal a fatal blow to ocean ports, and other opposition came from various railways who argued that they would suffer heavy loss of freight. Opposition was also made on the grounds of the initial cost of the project.

As a result, in 1934, when a vote was taken in the United States Senate, the Treaty failed to receive the two-thirds majority required for its ratification.

In 1938 the United States Government undertook to revive the St. Lawrence project and in that year the draft of a new treaty similar to that of 1932 was submitted to Canada. During the Second World War, the value of the seaway and its power resources was heavily underlined. Besides the obvious benefit of large ocean vessels being able to navigate the waterway in safety, shipyards on the Great Lakes could assist coastal yards in ship building. Moreover the 2 million horse power that might be generated from water-power stations situated in the International section of the St. Lawrence directed new attention to the project.

Pulp Freighter from the north shore of the St. Lawrence waiting its turn to be unloaded at Thorold.

In these circumstances, the Great Lakes-St. Lawrence Agreement was signed by Canada and the United States in March, 1941, which was similar to the 1932 Treaty but was drawn up in such a form as to not require a two-thirds majority for approval in the United States Congress. It also contained, with concurrence of the Canadian Government, a new aspect of the Agreement—the consideration of making the expenditure for navigation self-liquidating, by means of a system of tolls on shipping, thus reversing the policies of both Canada and the U.S.A., of providing free use of their inland waterways. While the President made a strong recommendation to Congress in June, 1941, the bill introduced in Congress, to obtain approval of the Agreement, was again delayed in Committee. In view of this, approval of the Agreement was not sought in the Canadian Parliament although it was tabled there. No further action was taken during the War.

RECENT DEVELOPMENTS

It is not until 1946 that a new stage was reached in the St. Lawrence River Waterway project, when a favourable report of

The Saint Lawrence Seaway—continued

Aerial view of the Central Harbour district of Toronto, Lake Ontario.

the United States Senate approved the Agreement with Canada for a Commission representing the two countries to prepare plans for power and navigation facilities and then to let a contract and supervise construction. Estimates had been made and the division of the costs between the two countries agreed. In the meantime, however, the proposed depth of 27 feet in the river and 30 feet in the lakes was being criticised as inadequate. In 1947 the approval of the Waterway project was given by the Sub-committee of the Foreign Relations Committee of the United States Senate. A further commitment was also made by the Canadian Minister of Transport with the announcement of the award of a five years' contract for dredging the St. Lawrence shipping channel. In a statement he drew attention to the importance of the St. Lawrence River to the ports of Montreal, Sorel, Three Rivers and Quebec. He also recalled the recommendations of the St. Lawrence River Ship Channel Committee of 1946, in particular the completion of dredging from Montreal to the sea, to 35 feet below L.W. O.S.T., widening of the channel from Montreal to Quebec to 550 feet and likewise below Quebec to 1,000 feet, increased anchorage areas and deepening of basins in Montreal Harbour to 35 feet below datum. In June, 1947, the Canadian Government also set up an Interdepartmental Committee to examine all current questions relating to the seaway and power project.

Early in January, 1948, the United States Senate embarked upon a debate on the St. Lawrence Seaway Bill and President Truman, as did his predecessor, appealed for support of the project on the grounds that it would "strengthen and expand industry, agriculture and domestic and foreign trade of the United States." He also argued that it would develop the largest hydro-electric power station in the country and contended that the project was virtually essential to national defence. There was, however, heavy and significant opposition to the Bill and many cogent and seemingly convincing reasons for its rejection were advanced by statesmen. When the measure was put to the vote at the end of February, 1948. the Senate, by an impressive two-to-one majority, voted for sending the St. Lawrence Seaway project back to committee for further study.

From that date to the middle of the present year, addresses were made on the subject to Congress, and hearings before the House Public Works Committee have been held. but many of these appear to have been boycotted, apparently because they felt that Congress was apathetic to the matter. No further hearings appear to be scheduled and it seems that the Committee may postpone any further action, and will wait for the Senate to act, and, by taking this decision, they have assured a postponement by the United States of any further development for many years.

In the meantime much attention in the U.S.A. has been focussed upon other aspects of the scheme, for example, the gradual exhaustion of the country's iron-ore resources, the increasing development of the iron-ore deposits discovered in 1929 in Quebec-Labrador, and the desirability of easy transportation to the steel plants of the Middle Western States of the U.S.A., that is to say via the St. Lawrence. The urgency of a decision on this point, in view of the present World political situation, has been emphasized by Senator Wiley before the Senate in June of this year.

There has also been a move in the States to endeavour to separate the Seaway part of the St. Lawrence project from the hydro-electric power portions of the scheme, but President Truman has indicated that he takes a definite stand upon the principle that the two aspects of the St. Lawrence project must go forward together. On the other hand, it is said that the Seaway Scheme has been steadily gaining adherents from the opposition, and that there is considerable activity among the protagonists of the project. Certain labour organizations of the Middle West affiliated to the C.I.O. have called for early action and the American Federation of Labour appears to be evincing interest in the scheme.

In Canada, nothing has apparently happened to decrease faith in the benefits which would come to that country and the question is often asked, why should the St. Lawrence Seaway be considered as necessarily an international project when 85 per cent of the power to be developed from it will be for Canadian use, and when it is estimated that the greater percentage of the freight traffic will come from Canadian sources, and that the greater length of shore line involved in the proposed improvements is upon Canadian soil? However, up to the present, there is no information that any official or political action on these lines is likely to be taken by the Canadian Government. Neither is there any indication as to what its next move will be.

SOME ARGUMENTS FOR AND AGAINST THE ST. LAWRENCE SEAWAY PROJECT

As far as Canada is concerned, it seems that the construction of the St. Lawrence Seaway has been viewed from its inception, as a great economic plan for the development of the continent of North America, both as a practical aid to shipping on the Great Lakes and also as affording facilities for deep sea vessels to call at the interior ports of both Canada and the United States, thus developing national and international shipping. In addition, the

The Saint Lawrence Seaway—continued

generation of electricity from the hydro-electric stations embodied in the scheme, has been recognised as going far towards solving the serious lack of power which is being experienced in both countries.

The large Great Lakes' ships could discharge their cargoes at Montreal, industries in Ontario could ship direct from Toronto, and grain could be exported to all parts of the world by steamship. Millions of tons of high grade iron-ore could also be shipped from Labrador to Lake Erie ports.

While some objections and criticisms have been made in Canada to certain aspects of the scheme, opposition to the principle of the Seaway has come, not surprisingly, from certain railway, canal and port interests in the United States, which, up to the present, have afforded alternative trade routes. These interests fear the adverse influence on their freight tonnages of a through route for shipping, as against the present one of interrupted stages, with repeated handling of commodities. No doubt the north eastern railways may lose some traffic to and from the Middle West and the north eastern ports some import and export traffic. It has been stated, however, that these possible losses would not represent more than 2 per cent of the country's railway traffic, and not more than 4 per cent of the traffic of the eastern states, and that fluctuations greater than this occur normally in railway operations, from season to season. Unfortunately this opposition, by reason of intense propaganda and organization, has spread through affiliated interests in banking, insurance and trade associations to all parts of the country, and has had disastrous effects upon the passage of the St. Lawrence Seaway Legislature whenever it came before Congress.

Apart from these objections to the waterway from a sectional point of view, other arguments have been raised, not so much against the principle of it, but against certain aspects of the scheme. The most cogent of these appears to be the question of the depth of the Seaway. The proposed depth of 27 feet in the river, with 30 feet over the lock sills, has been criticised as inadequate on the grounds that the permissible ship draft would be only 25 feet, while a great majority of entrance locks and navigable channels of the world's docks and harbours provide depths of 30-45 feet, to accommodate vessels of 30 feet draft and over. It certainly seems that this important question will bear some further searching and examination in order to avoid any initial mistake being made.

Some doubts have been expressed about certain physical characteristics of the scheme, as the Seaway would be icebound and useless from early December until late April. In this respect Mr. J. G. G. Kerry, M.E.I.C., has carried out a great deal of scientific study of this subject and appears to be well qualified to express his views on the solution of many of the difficulties involved. He claims that the waterway designers, being limited in their studies by the stipulated 30-ft. deep channel, have not sufficiently considered the winter temperatures of Lake Ontario, and have made no attempt to utilize the heat, which is at all time present in those waters, to keep the waterway free of ice. He says that a channel 50 feet deep and wide enough can be built that will pass this warm water from Lake Ontario to a point well east of Quebec, where the waters of the river will discharge into a broad and deep arm of the sea that never freezes over.

Mr. F. S. Small, M.E.I.C., another engineer of repute in hydraulic engineering, has produced a scheme for the Lachine section of the St. Lawrence and the fullest development of all the resources of this part of the St. Lawrence and Ottawa Rivers. This proposal, which is necessarily only preliminary in form, but which is the result of extensive studies and research, is given in the August 1950, issue of the Engineering Journal of the Engineering Institute of Canada.

Other objections from the United States have been raised on the grounds of defence, it being asserted that a lock-structured waterway could be easily rendered useless by enemy action, and the recent administrative request for a large sum of money for a safe sea-level Panama Canal, is cited in support of this argument. Opponents of the project go further, and say that the Seaway is not vital to the defence of the U.S.A. and would, moreover, be a net addition to defence problems. This is an argument, however, which can be brought against the construction of many other projects, which may be conceived for the economic benefit of mankind.

Finally there is the financial aspect which in certain American circles resolves itself into the question—whether the Seaway and Power project warrants priority—in view of the country's large outlays to assist recovery abroad. It is also pointed out that the United States is already committed to the building of a sea-level Panama Canal or contriving some other means of making that unquestionably vital sea-passage less vulnerable in the event of war, and the question is asked, can the U.S.A. undertake the St. Lawrence project and the Panama Canal simultaneously? If the answer is in the negative which of the programmes comes first?

It is necessary to distinguish, amongst the mass of controversy which exists in the States, those objections and arguments which are based upon doubts which are well founded, from those arising from purely sectional interests, which, although possibly sound as to their basis, must not be allowed to assume too great an importance if it can be proved that the project would ensure the greatest good for the greatest number. In other words the Congress of the United States should not be swayed by sectional interests but should decide this important matter on the broadest national considerations.

In view of the frequent shelving of the project by the United States many Canadians contend that serious consideration should

Ice Breaker at work in the St. Lawrence.

be given to the possibility of Canada proceeding by herself with her own part of the scheme. A proviso is added, however, that the question of depth to accommodate the largest ocean-going vessels is provided for, and that the problem of ice obstruction is scientifically investigated as an integral part of the scheme.

ENGINEERING WORKS INVOLVED IN THE SEAWAY

The International Section.

The International Section of the St. Lawrence comprises the Thousand Islands and International Rapids to the point south of Cornwall Island where the international boundary cuts across the south bank of the river. The principle engineering works of the Controlled Single Stage Project planned for this area are:—

1. A control dam in the vicinity of Iroquois Point.
2. A dam in the Long Sault Rapids at the head of Barnhart Island and two power houses, one on either side of the international boundary, at the foot of Barnhart Island.
3. A side canal, with one lock on the United States mainland to carry navigation around the control dam, and a side canal, with one guard gate and two locks, on the United States mainland south of Barnhart Island to carry navigation from above the main Long Sault Dam to the river south of Cornwall Island.
4. Dykes, where necessary, on the United States and Canadian sides of the boundary to retain the pool level above Long Sault Dam.
5. A channel enlargement from the head of Galop Island to below Lotus Island.

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6. A channel enlargement between Lotus Island and the control dam, and from above Point Three Points to below Ogden Island.
7. The necessary railroad and highway modification on either side of the international boundary.
8. The necessary works to permit the continuance of the 14-ft. navigation on the Canadian side around the control dam and from the pool above the Long Sault Dam to connect with the existing Cornwall Canal.
9. The rehabilitation of the towns of Iroquois and Morrisburg, Ontario.

Grain Boat passing under a large railway lift bridge on the Welland Canal, an important link in the Great Lakes system, joining Lake Erie with Lake Ontario.

The Canadian Section.

The Agreement provided for the completion of the Canadian section of the deep waterway which extends a total distance of 67 miles from the head of Lake St. Francis to Montreal. The Canadian Section is divided into three parts.

1. **Lake St. Francis Section.** This extends from the foot of Cornwall Island to the foot of Lake St. Francis, a distance of 26 miles. The provision of a navigable channel 27 feet in depth through Lake St. Francis would necessitate the removal of eight projecting points and the excavation of a channel 2,000 feet long opposite the village of Lancaster.

2. **Soulanges Section.** This extends from deep water at the foot of Lake St. Francis to deep water at the head of Lake St. Louis, a distance of 18 miles in which the river falls 83.5 feet in a succession of rapids. It would be necessary to dredge an entrance channel from deep water in Lake St. Francis to the entrance of the Beauharnois Power Canal, and to excavate one short side canal with locks to pass from the power canal to Lake St. Louis. Two fixed bridges would have to be replaced by vertical lift spans over the power canal.

3. **Lachine Section.** This extends from deep water at the head of Lake St. Louis to Montreal harbour, a distance of 23 miles. The project planned for its improvement was that recommended by the Joint Board of Engineers in 1926: it consists of a side canal 10 miles long from Lachine to deep water at Montreal, and a dam across the river at Ile aux Diables to maintain the level of Lake St. Louis. A pair of guard gates and three lift locks would be required to overcome a fall of 53 feet in the river level in this section.

Since 1926 changes have occurred which will necessitate a revision of the 1926 plan for the improvement of the Lachine Section. In 1947 a Board of Engineers was appointed to prepare a satisfactory plan with estimates of cost. Their report, dated October 15th, 1948, giving a plan with a number of variants for the development of the power and navigation resources of the main river, is now being studied.

Hydro-Electric Power.

The development of the International Section of the St. Lawrence as provided in the 1941 Agreement would make available 2 million horsepower which would be divided equally between Canada and the United States. At the same time as the 1941 Agreement with the United States was signed, the Canadian Government entered into an agreement with the Government of Ontario providing that the Canadian share of the power developed in the International Section would be made available to that Province. This development, with those currently under way on the Ottawa River, constitute the only remaining major sources of power available to southern Ontario.

Estimates of Costs.

In 1941 the total cost of the Seaway was estimated at $544,059,000, including the cost of those works already completed. Canada's share of this cost was estimated at $264,003,000 which included the $131,900,000 already spent on the Welland Canal. Increased costs since 1941 undoubtedly necessitate an upward revision of these estimates and the matter is presently being studied.

In 1941, it was estimated that the total future expenditure required by Canada and Ontario would be $131,632,000. This included the cost of developing Ontario's share of power in the International Section. Under the 1941 Canada-Ontario Agreement $89,289,000 of this total would be assumed by Ontario.

For the use for navigation purposes of facilities already constructed in the Soulanges Section for navigation and power purposes the Federal Government, in 1941, offered to pay the sum of $7,972,550 to the Province of Quebec.

In this survey, necessarily brief, the author has endeavoured to present a summary of the past history and the salient aspects of the St. Lawrence Seaway Project. In Canada and the United States of America there is a wealth of information published on the subject, and it is no easy matter to abstract the relevant facts from among naturally biased statements made by representatives of interests which may be affected by the project.

The author acknowledges with thanks the help he has received from many publications—New York Times, Canada's Weekly Shipping Register and Shipbuilder (Montreal), Work Boat (New Orleans), Great Lakes Outlook (Milwaukee), the St. Lawrence Deep Waterway, by C. P. Wright (Toronto), and the Engineering Journal of the Engineering Institute of Canada.

TENDERS FOR IMPORT WHARF AT AUCKLAND.

The Auckland Harbour Board has announced that tenders for the construction of a new import wharf at the Port of Auckland will be called immediately, and will be opened at the first meeting of the Board early next year. The new wharf will be 1,200-ft. long and will provide berths on each side for two large overseas ships. No recent estimates of the cost have been announced, but in 1938, it was estimated that the work involved would total well over £1,300,000. The contract will be advertised in the United Kingdom and Australia, and the specifications and documents will be lodged with trade commissioners and foreign consuls. It is hoped that at least two of the four berths will be available within two years.

Labour Problems at the Port of Antwerp

The Incidence of Unemployment and Strikes

(By a "Lloyd's List" Special Correspondent)

The problems concerning the employment of dockers and the improvement of their working conditions and rates of pay, in order to have a contented labour force, are not confined to one country only, but are world-wide. This problem of port working is particularly acute at a number of Continental ports, and we are publishing for the benefit of our readers, with due acknowledgment, an informative article which appeared in "Lloyd's List" on the 7th September last.

One of Antwerp's most alarming problems is the incidence of unemployment and strikes among port labour. The problem affects the prosperity and may even affect the future of the port. Port labour, therefore, deserves special attention.

A study of returns made by C.E.P.A. (Centrale des Employeurs au Port d'Anvers), since 1930 (excluding the war years), brings to light the following information on the numbers of labourers and the opportunities of employment:—

	Monthly average of labourers	Monthly average of tasks done	Oversea imports and exports*
1930	15,871	16.55	22,171
1931	16,133	14.94	20,812
1932	14,958	13.44	17,427
1933	14,943	14.51	18,952
1934	14,509	14.69	20,887
1935	14,651	15.74	23,241
1936	16,025	16.05	25,249
1937	18,603	17.55	28,425
1938	17,506	13.93	25,579
1939	15,553	13.07	20,655
1945	18,220	20.94	—
1946	14,062	16.76	11,817
1947	16,137	19.12	22,206
1948	15,369	15.84	20,946
1949	14,078	15.27	19,850

*In thousand metric tons.

A certain number of labourers do not readily take advantage of opportunities of employment, and when they do they often work unsatisfactory. In times of prosperity each labourer performs an average of at least 16 tasks per month, and this figure dropped to 14 in years of crisis.

CONSEQUENCES OF SOCIAL SECURITY

For the employers it is being pertinently argued that the introduction (about three years ago) of the so-called "social security scheme" for port labourers has had grave consequences. The greater part of the labourers are tempted by the allowance they receive when doing no work. Such a system must inevitably lead to an abnormal situation. In the public's opinion the allowance under the scheme is tantamount to a "laziness bounty." The phrase has a hard note as the majority of labourers are perfectly willing to comply loyally with the wage conditions—the troubles being generally brought about by a minority, especially those of Communist tendencies.

So unemployment—whether forced on the labourers or "voluntary" accepted by a certain number of them — remains an extremely acute problem which is stressed by the official returns. The daily average of controlled unemployment was still at a high level in July, 1950, being 3570. Figures must be gauged in the light of daily averages in the present year compared with 1949 :—

	1950	1949
January	5810	——
February	5673	——
March	5945	6503
April	4946	6199
May	4722	6069
June	4366	5560
July*	3570	5861

*Including the 29th—the day on which the strike started.

The above figures refer only to dockers, i.e., holders of C.E.P.A. wagebooks. Coal heavers are not included; figures for January and February, 1949, are missing owing to the fact that differentiation between the two groups could only be made from March of that year. However, coal heavers may be disregarded as their number, owing to the nature of their work, is not very considerable—a few hundreds—and, moreover, their number necessarily fluctuates on account of the seasonal character of their work.

A DECLINING TENDENCY

As can be seen, the figures show a tendency to decline. This fact might seem to augur well for the future, but a too optimistic and possibly premature conclusion should not be arrived at, because several factors must be taken into account.

Generally speaking, it may be said that: (1) The returns of the unemployed for July, 1950 (making allowance for the two days ending the month when the strike affected all dockers) are the most favourable that have been recorded during the present year. Moreover, they are much better than the returns for the corresponding month of last year, when unemployment was roughly 60 per cent. higher.

(2) On the whole, during the years 1949 and 1950 a constant tendency may be observed towards a reduction in the number of unemployed dockers.

(3) An examination of course of unemployment from 1946 to 1950 shows that at the end of July last it had practically reverted to its corresponding 1946 level. In 1946 the port was still suffering from the decrease in activity owing to the ending of military traffic. Moreover, in 1947, unemployed workers were reabsorbed considerably by the sudden economic boom. The following year saw the beginning of the economic crisis which developed and reached its climax in the last month of that year. It has been officially stated that at that time about 7,000 dockers and coal heavers were daily unemployed. This figure represented almost half the total number of the men on the port labourers' register. Since 1949 there has been a slight but persistent tendency for unemployment to decline.

AGGRAVATING THE PROBLEM

At this stage, it is necessary to stress, as I have done on previous occasions when analysing the port labour problem, that the unemployment problem in which the port of Antwerp has become involved since 1948 has been aggravated by an increase, which has been maintained, in the number of registered labourers. In this respect it is well to recall that at the Liberation the number was pushed up to a very high level. During the period from the end of 1944 to about October, 1945, when military traffic was at its height, the average daily number of dockers had risen to a little short of 20,000. With the discontinuance of this traffic and the gradual return of commercial traffic, the average daily number of dockers dwindled to 16,100 by January, 1946, and dropped further to 15,197 in April, 1950.

These reductions were the result of the withdrawal, at intervals, of the wagebooks of unskilled or insufficiently trained labourers and of the voluntary leaving of labourers for other kinds of work. Also, of course, a certain number of men had reached the age limit and, obviously, were not replaced. At present, the precentage of unemployed port labourers may be assessed at about 35 per cent. of the number of registered men. This figure is still far too high and must be cut down by a gradual reduction of the register, though admittedly it is dangerous to reduce below a prudent limit in view of the necessity of having a reserve of labour available to cope with any rush in case of a renewal of normal activity.

COST OF LABOUR

Mention of average costs for work done by labourers may be of interest. It is almost impossible to give accurate figures because, for instance, if it proves very difficult to calculate the cost of a shift, it is quite impossible to establish the cost per ton of cargo handled. Traffic handled during a year comprises some goods which entail little manpower and some which require full gangs and, when discharged on the quay, require further handling. It is not possible to calculate the handling cost for any one com-

Labour Problems at the Port of Antwerp—continued

modity as the returns make no discrimination between the dockers handling ores, for instance, and those handling bales of cotton or other general cargo. However, on the basis of the wages paid by C.E.P.A. for account of the associated members, I find that on a broad average the cost of handling commodities (loading and discharging, and excluding bulk oils) works out at 8.70 Belgian francs per ton in 1938 and 35.15 francs in 1949. This represents a proportion of about 1 to 4

On the other hand, on studying the work done by the labourers in the course of a full year, I find that the tonnage handled per task was 7.73 in 1938 (last normal pre-war year), 5.43 in 1947, 6.36 in 1948 and 6.92 in 1949. These figures show a serious decline in 1947, but point to an improvement in subsequent years. This endeavour to improve dispatch should not be jeopardised by a recurrence of strikes.

The agitation throughout the country caused by the return of King Leopold III was rapidly appeased when he transferred power to his son, Prince Baudouin, but the port labourers of Ghent and Antwerp who had struck to assert their opposition to the return to the throne of the king did not return to work immediately, so that the strike, which originally had a purely political character, and, moreover, was only partial, was converted into a more widespread strike for material advantages.

DOCKERS' CLAIMS

The labour unions were claiming: (1) An additional pension for the dockers over 65 years of age. (2) An increase of the bonus when working in consecutive shifts (the bonus was 8 Belgian francs for the morning shift and 16 francs for the afternoon shift, and the delegates of the unions proposed 25 francs in both cases). (3) A uniform allowance of 20 francs for all shifts and payable to all labourers as a" premium for dispatch and clothing "; this premium would be payable periodically, say every quarter. (4) The maintenance on the register of the dockers aged between 55 and 65, even though they may not carry out a sufficient number of tasks during each " reference period." The last claim clearly demonstrated resistance of the unions to the cutting down of the surplus of labour which I have been strongly advocating. The claim was all the more unreasonable in view of the fact that the output of men over 55 shrinks rather rapidly.

In the meantime the port has been passing through a grave crisis and at a time when it is imperative to compete with other foreign ports, particularly Rotterdam. As C.E.P.A. have stressed, in consequence of the high wages and social charges, the port of Antwerp has become too expensive. Yet in spite of such facts, new claims were brought forward which were bound to increase the cost of cargo handling. When the docker was in employment he obtained as minimum wages 209 francs for seven hours' ordinary day work. He was being paid various supplementary amounts for shift and night work, apart from other extras. When unemployed, he received a minimum of 111 francs per day.

C.E.P.A. pointed out that the average wages of other labourers were 18.82 francs per hour. Rates for other dockers were 13.54 Belgian francs at Rotterdam, 13.03 Belgian francs at Dunkirk, 15.23 francs at Hamburg and 7.50 francs at Gdansk. The Antwerp docker, however, received a minimum of 29.85 Belgian francs per hour. It was also necessary, of course, to take into account social charges (including the " social security scheme " already referred to), which brought the average cost of the Antwerp docker to a minimum of 41 francs per hour, against neighbouring ports' costs of between 19 and 22 Belgian francs per hour. Not only did the Rotterdam docker work eight and 8½ against the seven hours of his Antwerp colleague, but the cost of the former was less than half that of the latter. Such discrepancy had already proved a serious handicap for the port of Antwerp.

ROTTERDAM VERSUS ANTWERP

In the light of the strike which, besides the high tariffs, placed Antwerp at a disadvantage compared with Rotterdam, it is interesting to study the shipping movement of both ports for the first half of 1950 and 1949.

Number of ships cleared inwards

	Rotterdam	Antwerp
1950	6130	5043
1949	5741	4740
Increase	389	303

Net tonnage cleared inwards

	Rotterdam	Antwerp
1950	9,134,000	9,067,000
1949	7,533,000	8,553,000
Increase	1,601,000	514,000

From these returns it can be seen that shipping movement has developed more favourably at Rotterdam than at Antwerp. They show that on June 30, 1949, Rotterdam had cleared inwards 1001 more ships than Antwerp, and on June 30, 1950, the difference was 1087.

However, the position regarding the tonnage is quite different, and we find that in the space of one year Rotterdam shows a gain which is more than three times that at Antwerp. This fact would point to Rotterdam receiving ships which on an average are larger than those calling at Antwerp. I may mention, too, that since April last the monthly tonnage at Rotterdam began, for the first time since the end of the war, to exceed that of Antwerp, and the difference is increasing in favour of the Dutch port.

SHIPPING MOVEMENT

An examination of the shipping movement in the course of the months of May, June and July shows that in May the number of clearances of sea-going vessels amounted to 941, of 2,003,902 Moorsom tons net (Belgian standard measurement), showing an increase of 147 ships and 172,639 tons, which was very satisfactory. The British flag maintained the lead with 232 ships, of 481,485 tons, followed by the Dutch with 227 ships, of 347,349 tons. June showed a drop in the movement, recording 902 ships, of 1,936,138 tons, the British flag being in first position with 214 ships, of 440,514 tons, followed by the Dutch with 195 ships, of 351,644 tons. July saw a further decrease in the clearances, with 808 ships, of 1,798,287 tons. British vessels numbered 182, of 374,996 tons followed by Dutch with 167 ships of 299,211 tons.

The Scandinavian group (Sweden, Norway, Denmark, Iceland) shared the traffic with following percentages: May, 21.7; June, 23.6; July, 25.4. Percentages for the Belgian flag were 7.1, 7.8 and 7.3 respectively, and the German flag 1.88, 2 and 1.82 respectively. On the strength of the returns, the steady progress of the German flag deserves to be stressed if we consider that while for the first four months of the present year its share was 83,619 tons, for the three months under consideration it reached 109,291 tons. The progress of the German flag is all the more conspicuous since in July, 1949, it ranked 15th in the movement of the port, with a share of 0.67 per cent. in the total tonnage, while in July, 1950, it had advanced to the 8th position. August was a disastrous month for the port owing to the strike which started on July 29.

NO DEVELOPMENT OF FLEET

There is still no development of the Belgian merchant fleet. This fact can be seen alone by the low share of the Belgian flag in the shipping movement of the port. According to official figures, on August 1 the Belgian fleet comprised 45 motorships and 47 steamers, totalling 416,269 tons gross, of which 20,137 tons are laid up. The latter figure represents 14 ships which were previously engaged in tramping but which have been withdrawn from service because owners are finding it impossible to continue working the ship as long as the British sterling in which freights are generally paid is not convertible.

In the meantime, legitimate anxiety is being felt in certain quarters regarding the amount of national tonnage Belgium would have in the event of international emergency. The country would then have to be largely dependent on foreign tonnage for the carriage of vital overseas goods. Disappointment at the inadequacy of the fleet is all the more keenly felt as the total gross tonnage of the Dutch fleet is seven times larger.

Ship Fumigation*

Outline of Some Methods Employed

By J. G. McCOY
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1—GENERAL REMARKS

In presenting this paper, I have divided the subject into two parts, namely, "Fumigants," which includes methods of use, and, "Fumigation" which includes preparations for fumigation, prefaced by the following remarks:

Ship fumigation is usually carried out to obtain a certificate of deratisation, or to destroy bugs, fleas, cockroaches or any other pests that might infest the ship; or, possibly both. Fumigation should not be confused with disinfection. A fumigant may, as in the case of sulphur (SO2), also be a disinfectant, but hydrogen cyanide (HCN), although a fumigant, does not destroy germs.

The International Sanitary Convention, 1926, Art. 28, and Port Sanitary Regulations 1933, Sec. 19, require that all ships, except those employed in the national coastal service, shall be periodically deratised, or to be permanently so maintained that any rat population is kept down to a minimum. In the first case they shall receive deratisation certificates, and in the second, deratisation exemption certificates. These certificates are valid for six months, although this period may be extended by one month in the case of a ship proceeding to its home port. The certificate may only be granted at an "Approved Port," that is, a district in which a medical officer is authorised by the Minister of Health to grant these certificates. Both the form of certificates, and the conditions under which they are issued are similar throughout the world, although it must be admitted that there are slight variations in different countries, and the standard adhered to is not in practice altogether uniform.

The Port Health Authority may carry out the fumigation themselves, or cause such operations to be carried out under their direction and control. The latter is preferable, principally because a high standard may be rigidly enforced by a very small Port Health staff, and although Articles 28 and 18 of the International Convention require that the Sanitary Authority may not, on the whole, derive any profit from the operation, it is better that the Authority should have no financial interest whatever, except the small fee for the issue of the certificate, which is determined by the Ministry of Health after consultation with the Chamber of Shipping, and other interested bodies.

Before determining on fumigation, it is most important that the ship is thoroughly searched in every compartment, and the number of rats present accurately estimated. (For instance, a large passenger ship may be examined for a deratisation exemption certificate and the searcher may discover some stale rat droppings, and wrongly conclude that there are rats in the ship. Fumigation is requested. This might involve everybody leaving the ship and being accommodated ashore, considerable expense and possibly delay to the ship. If, after fumigation, no dead rats were found, the shipowner or master would very rightly have a grievance against the Port Health Authority.) All ships should, whenever possible, be searched after fumigation, and the number of dead rats found entered on the certificate.

It is not always necessary to fumigate the entire vessel. If evidence of rats is confined to a separate watertight space or compartment, it is usually sufficient to fumigate the space concerned, although if the evidence is widespread, it is advisable to fumigate the whole ship.

The cubic capacities of spaces to be fumigated can usually be obtained from plans carried by the ship concerned. "Grain capacities" (that is measurements taken to the top of beam and skin of ship) should be used. If in doubt always take the greater capacity.

Fumigation companies, working under the control of Port Health Authorities, should be firms approved by the Authority, possessing an experienced and reliable staff, and suitable equipment.

Fumigants approved by the Ministry of Health for the deratisation of ships are:—HCN (Hydrogen Cyanide), and SO2 (Sulphur). I have noticed recently in certificates issued at one or two ports abroad that Methyl Bromide has been used, but this fumigant is not used in this country for the purpose of deratising ships, although I have seen it used in barges for other purposes. Most fumigations are carried out with HCN.

Fumigation should be carried out when the ship is empty, and if possible, in daylight. The date and time of fumigation is mutually arranged by the Shipping Company, Fumigation Company and Port Health Authority. The place of fumigation may be any berth approved by the local Harbour Board or Authority, but in no circumstances should fumigation with a lethal gas such as HCN be carried out in a ship which is lying alongside another.

Preparation for fumigation is usually made by the Shipping Company. The Port Health Inspector controls and directs the fumigation and checks the preparations, the distribution and weight of gas, sealing up and exposure. The Fumigation Company is responsible for generally satisfying the inspector's requirements, safety precautions, releasing gas, opening up, testing and certifying the vessel free from gas on completion.

When fumigating with HCN, the Fumigation Company obtains, prior to fumigation, a certificate from the officer in charge of the ship that the crew are ashore, and that no unauthorized person is on board the ship. The responsibility that no unauthorized person boards the vessel throughout the operation, must be shared by both the Shipping Company and the Fumigation Company. The inspector, although not legally responsible, has a moral responsibility for ensuring that no accident occurs.

The inspector and fumigation operators should be fully trained in the use of a gas mask, and be competent to administer first-aid. As some knowledge of the fumigant, and careful preparations before fumigation are essential, I will attempt to describe them.

11—FUMIGANTS

I propose to describe two fumigants namely Sulphur (SO2) and Hydrogen Cyanide (HCN).

(a) Sulphur (SO2)

Sulphur is known as a fumigant to almost everybody. SO2 is generated by burning sulphur. It is not so effective or penetrating as HCN. The gas is slightly heavier than air and tends to move downwards. It is generated better in the presence of water. All foodstuffs, excepting tin stuffs, should be removed from space to be fumigated. The sulphur should be dry and distributed in open containers or buckets containing not more than 9 lbs. The containers are placed in trays containing water, distributed as required. The sulphur in the container is piled up into a pyramid, and in the centre is inserted a handful of wood-wool, which is soaked in methylated spirits, and then ignited. Care must be taken that there is no danger from fire. There are other methods of fumigating ships with SO2, but the method described is the best known and that most commonly used. The crew may remain on board during the fumigation. For deratisation, the minimum quantity of sulphur allowed is 3 lbs. per 1,000 cubic feet, and the minimum exposure six hours. (Six hours exposure is only allowed in exceptional circumstances when the holds are clean, and dunnage stacked clear of the deck. Uusually, eight hours or more are required.)

(b) Hydrogen Cyanide (HCN)

Hydrogen Cyanide (HCN) is sometimes known as hydro-cyanic acid gas, and occasionally as prussic acid gas. It has been known to chemists since the eighteenth century, but has only been in use for ship fumigation during the past 25-30 years.

It is a lethal gas, colourless and a little lighter than air. It is supposed to have a faint almond-like odour, but many people cannot smell it. It is mixable with water and other liquids, and is very penetrative. It burns, and in a very concentration could form an explosive mixture. At low temperatures the gas comes off slowly, but in high temperatures, very quickly. It does not injure paintwork, metals, textiles or dry stores, but affects anything containing moisture. All meats, fats, etc., must be removed from the fumigation area.

*Paper read at the 57th Annual Conference of the Sanitary Inspectors' Association held at Bridlington, September, 1950. Reproduced by permission.

Ship Fumigation—continued

When fumigating, everybody except the fumigators and the inspector must be properly accounted for and leave the vessel before the fumigation commences. They must not be allowed to return until the vessel is certified free from gas.

Even when wearing a mask it is dangerous to remain in high concentrations for long periods; and even when in low concentrations for comparatively short periods, one's clothes become saturated with it, and it even gets into the moisture in the tobacco in your pocket and later on the smoke tastes abominable.

When first used for fumigating ships, the "Barrel" or "Tipping" method was used. This consisted of dropping sodium cyanide into a mixture of sulphuric acid and water. It was very dangerous, particularly when removing the barrels after fumigation, as, when the liquid was disturbed, the gas came off again. Fortunately this method is now obsolete.

Later, the liquid was stored in small drums or metal bottles, and poured into the compartment to be fumigated and allowed to evaporate; (to avoid staining floor coverings, the liquid was often poured into trays or on to tiled floors).

A better method, still in general use, is that the liquid is sprayed under pressure into the space to be fumigated. The liquid is contained in large 75-lb. cylinders, and is then usually syphoned off into smaller applicators holding approximately 15 lbs. A pressure of 50 to 70 lbs. is then obtained by an air pump or other means, and the liquid is then sprayed into the space as required. As the gas is lighter than air, care must be taken that the gas is sprayed at the lowest possible level.

Another method in general use is that of using an absorbed gas. The gas may be absorbed in an infusorial earth (Kieselguhr), or clay (gypsum), or absorbent discs, or a soft wood pulp. Whatever the absorbent material, the gas is sealed up in gas-tight tins of varying sizes. The tins of HCN are taken to the space to be fumigated, opened with a patent opener, and distributed as required. In accommodation, the absorbed gas is usually spread on a large sheet of stiff brown paper which protects the floor covering and makes it easy to remove the residue after fumigation. Once a tin is open all the contents must be used up.

The quantities of gas used and exposure given, vary considerably with the pest or vermin that it is intended to destroy. When used as an insecticide in sufficiently high concentrations, the gas will destroy not only the insects but their eggs.

For deratisation, the minimum quantity of HCN allowed is 2 ozs. per 1,000 cubic feet, and the minimum exposure two hours.

111—FUMIGATION

Whatever the fumigant, it is essential that careful preparations are made before fumigation is commenced. The preparations can be divided into those taken by all ships whatever the fumigant, and special precautions which must be taken when fumigating with a lethal gas such as HCN.

(a) Preparations

The general plan of campaign is decided upon. Cubic capacities of spaces to be fumigated are checked, and the appropriate quantities of fumigant are weighed and distributed. The funnels and all ventilators are adequately covered with canvas (wooden plugs also being fitted in ventilators where possible). All ports and windows are closed, outside doors and skylights and any outside cracks or crevices are pasted up, and made gastight. The hatches are covered with two (at least one good) tarpaulins, which are battened down.

The tween deck and peak hatches are taken off, or staggered. Dunnage is stacked at least 18 inches off the deck and limber boards covering the bilges are lifted (at least two each side). All doors, drawers, lockers, etc., are left open, except the bonded locker which should be on " extended seal " (that is, that the door is left slightly ajar, although sealed by H.M. Customs). All foodstuffs which may become contaminated are removed from the fumigation area.

(b) Additional precautions taken when fumigating with HCN

The police and harbour authorities are notified, and given any particulars they may require. In some ports the harbour authorities require a towing hawser ready on the fo'castle head, and lowered to the water's edge.

Warning notices are erected at the head and foot of the gangway, and also hung over the ship's rail at both sides of the vessel. They usually have the word " danger " in large red letters, followed by " This ship is under fumigation with hydro-cyanic acid gas, it is fatal to go on board."

A careful check is made to see that no tank lids are off, or water exposed, and all fires or naked lights are extinguished.

The fumigation apparatus is tested, gas masks tested and antidim applied to eye pieces, torches and testing materials are tested and the first-aid kit inspected and oxygen apparatus tried.

All keys in the ship are handed over to the fumigators and a watchman is posted at the gangway. Arrangements are then made with the officer and engineers in charge with regard to the return of the crew when the ship is gas-free.

When preparations are complete, the crew are checked ashore. The officer in charge, fumigators and inspector then satisfy themselves that no unauthorised person is on board, and the officer in charge gives the fumigators a certificate to that effect.

(c) Fumigation with SO2

After the preparations are inspected and found satisfactory, the containers or buckets of sulphur are counted and weighed, and the distribution checked. The inspector gives the signal to " light up," and stays until the sulphur is well alight. (The sulphur turns molten and burns with a low flame when well alight.) The gas comes off fairly quickly, and usually nobody needs persuading to leave the space being fumigated. When sealing up is completed the inspector notes the time and states the exposure required.

(d) Fumigation with HCN

When the preparations have been inspected and found satisfactory, and only the fumigators and inspector remain on board, the work of releasing the gas into the different compartments of the ship commences. The inspector gives the order to commence. During the release of gas the inspector and fumigators keep together, and the gas is only released into one space at a time. The exact amount of gas required is weighed or checked into each space fumigated, and the distribution is also checked to keep it as even as possible. In the case of " absorbed gas," each tin or part of a tin is checked, and when liquid gas is being used the applicators are weighed full and empty.

When the ship is under gas, a final inspection is made of the sealing up, the inspector notes the time, and states the exposure required. The inspector returns to the ship at the time arranged for " opening up," and re-inspects the sealing up.

Although HCN is lighter than air it is not so easily disposed of. Special attention must be paid to places where ventilation is difficult, and bedding should be beaten in the open air. In cold weather repeated tests are necessary. The crew's quarters should not be occupied during the night following a fumigation. The certificate of clearance, stating that the ship is free from gas is given by the fumigators before the crew are allowed to return to the ship.

In conclusion, I do not claim that the methods I have outlined are the only, or best methods, or that I have done more than touch upon the subject. Time, space, and your patience forbid more.

I present this paper in the hope that those experienced in ship fumigation will find it of interest and that those not experienced in fumigation may find it instructive.

EXPERIMENTS IN HARBOUR LIGHTING.

Experiments in lighting for New Zealand harbours were recently begun with the installation at the Lyttelton Harbour entrance of triangular neon signs as " leading lights." The work is being done by the Lyttelton Harbour Board, and, if successful, the Marine Department may try similar experiments elsewhere. Masters of all ships which trade to Lyttelton are asked to give their opinions as to the efficiency or otherwise of this new type of harbour lighting.

Port of Melbourne Improvements

Dredging Contract Now In Hand

In the September, 1950, issue of this Journal, we published a short article by Mr. A. D. Mackenzie, M.I.C.E., Chairman of the Melbourne Harbour Trust, in which reference was made to the construction of the new Appleton Dock project and the proposed River Entrance Docks scheme at the Port of Melbourne. At that time, the scheme had only reached the planning stage, and an announcement has now been made by the Melbourne Port Trust Commissioners to the effect that a contract worth £1,500,000 has been let to interests representing British and Dutch contractors. This contract is for the preliminary dredging of silt from the sea bed on the site of the new River Entrance works, and is expected to take about 2½ years to complete.

By careful planning the Melbourne Harbour Trust Commissioners have been able to carry out a considerable amount of new works and maintenance since the end of the war, despite the crippling shortage of Australian manpower and material.

The Commissioners realised that because of the many undertakings in progress throughout Victoria, overtaking wartime lag, heavy demands were being made on the State labour pool. After a detailed study of all circumstances, they decided that the most enterprising approach would be to obtain the services of overseas contractors who would bring machines and trained men to Australia, to carry out the work on the new docks scheme. A world-wide call for tenders was therefore made.

The dredging fleet, which arrived in Melbourne during July, after a 13,000 mile voyage from Ijfuiden, Holland, is made up of a bucket dredger, diesel tug, two diesel hopper barges, and ancillary small craft, manned by Dutch crews.

Housing had been prepared and was awaiting the newcomers—an old homestead converted and provided with cabins, kitchen, dining room, lounges.

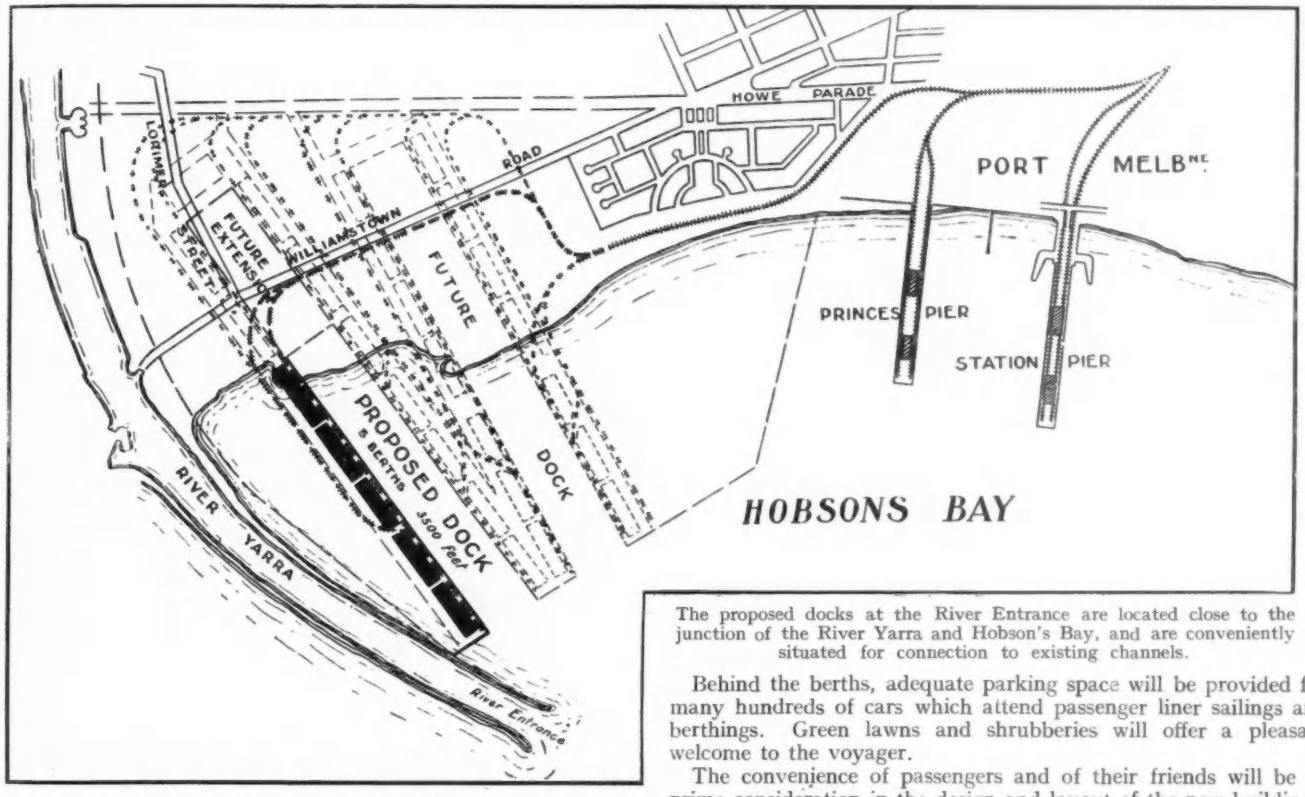
So that there shall be no delay, construction of berths and sheds is to proceed simultaneously with the second stage of the five-berth construction, when the dredger "G.F.H." is pumping clay and sand into low-lying and sea-covered areas, reclaiming them for road and rail approaches, wharfs, transit sheds and stores.

SITE OF NEW DOCKS

The plans now revealed, show that the River Entrance Docks will be located near the junction of the River Yarra and Hobson's Bay, a sheltered area conveniently situated for connection to existing dredged channels, and where good clay is met at moderate depths.

First stage of construction provides for five berths, which will cost about £3 million, and ultimately 28 berths will be provided in this dock system to meet the growing demands on the Port of Melbourne by large overseas liners. The complete project is shown in the sketch plan.

The new Docks will comprise longshore berths, ideally suited to Melbourne's passenger and trade requirements. There will be roomy transit sheds at each berth, wide road approaches, broad concrete-surfaced wharf aprons, several lines of rail tracks, and ample room for operation of cranes and mobile mechanical equipment.



The proposed docks at the River Entrance are located close to the junction of the River Yarra and Hobson's Bay, and are conveniently situated for connection to existing channels.

Behind the berths, adequate parking space will be provided for many hundreds of cars which attend passenger liner sailings and berthings. Green lawns and shrubberies will offer a pleasant welcome to the voyager.

The convenience of passengers and of their friends will be of prime consideration in the design and layout of the new buildings. Roomy Customs examination rooms, latest baggage handling equipment, spacious waiting halls, buffet, post office, kiosk, ladies' lounge, first-aid room, and Travellers' Aid Society rooms will be among the facilities provided by the Trust.

WIDE USE OF MECHANICAL HANDLING

The docks will feature the further extensive use of mechanisation. Already mechanical equipment in the Port has been developed to an advanced stage, and the new docks are to be given a generous provision of wharf cranes, to ensure rapid turn-round of the ships berthing to load and discharge cargoes.

The jib cranes, imposing brick cargo sheds (costing £100,000 each), spacious administrative and passenger reception buildings will bring a new skyline to the Melbourne sea approach, and vitality to this undeveloped corner of the metropolis.

The developing State of Victoria, whose potential is as yet practically untapped, will benefit from the provision of the new docks. About 90 per cent. of Victoria's seaborne trade passes through the Port of Melbourne, and the growing State will find the new facilities most welcome.

The British Transport Commission

Integration of Freight Services by Road, Rail and Inland Waterway

The British Transport Commission have now issued a further statement of policy, purporting to outline the methods to be adopted for integrating inland waterway services with those carried out by rail and road. Their previous statement dealt only with the policy of integration as it affected road and rail services. The text of the new announcement is as follows:

In the statement of policy issued by the British Transport Commission in July, 1950, it was stated that attention was being given to a definition of the objectives and methods of integrating services by inland waterway with those by rail and road. The inland waterways in the ownership of the Commission have been unified under the operational control of the Docks and Inland Waterways Executive and the carrying activities hitherto carried on by certain subsidiary and private companies in the ownership of the Commission, and by certain other carriers by waterway, are now being undertaken by the Executive.

The traffics for which rail and road transport are regarded as specially suitable and efficient were indicated in the statement of policy, and there would also be general agreement that transport by inland waterway is specially suitable and efficient for:

(a) Traffic imported and for shipment in the ports connected with the inland waterway system, particularly in those instances where overside delivery from ship to barge, or vice versa, takes place.
(b) Traffic which can be carried from point to point in barge loads.
(c) Traffic conveyed to or from waterside premises.
(d) Petroleum and liquids in bulk.
(e) Traffic requiring bulk movement and storage in the warehouses of the Docks and Inland Waterways Executive.
(f) Trunk haul to river or canal waterheads with subsequent delivery by the Road Haulage Executive.

While the Docks and Inland Waterways Executive must be responsible for the provision of all services on the canals owned by the Commission, other than the carrying activities of private firms, the Road Haulage Executive will eventually become responsible for the provision of all road services for freight within the Commission's control.

TRANSFER OF ROAD VEHICLES

The transfer of the road vehicles of the Docks and Inland Waterways Executive employed on collection and delivery services, ancillary to the waterways, to the Road Haulage Executive will be completed as soon as practicable, and the Road Haulage Executive will provide the services.

The Road Haulage Executive will provide feeder and distributive services to suitable points on the waterways and will employ the Docks and Inland Waterways service in appropriate cases for bulk movement of imported and exported goods.

The common supply service to be developed by the Road Haulage Executive will include the provision of vehicles of suitable capacity and design required by the Docks and Inland Waterways Executive so long as that Executive continues to operate road vehicles, and, meanwhile, that Executive will inform the Road Haulage Executive of the general scope of their requirements and any arrangements they have made for the acquisition of vehicles. Overhauls and repairs to such vehicles will be effected by the Road Haulage Executive wherever they have, or develop, suitable facilities and such a course is convenient and economical.

CO-OPERATION WITH OTHER EXECUTIVES

The Docks and Inland Waterways Executive will co-operate with the Railway Executive and the Road Haulage Executive in joint use of existing terminals and in promoting new joint terminals on modern lines under single control, and there will be full prior consultation and agreement between the three Executives upon all works schemes of possible joint interest.

The arrangements for exchange of selected officers and staff between the Executives will extend to the Docks and Inland Waterways Executive. In all commercial arrangements and policy the divisional traffic officers of the Docks and Inland Waterways Executive will maintain the closest contact with the corresponding officers of the Road Haulage and Railway Executives. The Docks and Inland Waterways Executive will participate with the Railway and Road Haulage Executives, in the arrangements already announced to secure integration of freight transport by the services of the Commission.

New Technique in Division of Cargo Ships

A new British invention which enables cargo ships to carry with equal ease either grain cargoes in bulk, or relatively small pieces of cargo such as motor cars or tractors, was described recently at the Baltic and Mecantile Shipping Exchange in London.

Britain's coal exports are less than pre-war, which in turn were less than in 1913, and it is not always possible for tramp ships to find a coal cargo to, say, South America, where they must go to pick up grain for this country. This sometimes leads to ships going out in ballast where they are not suitable for taking the cargoes which are available for export, among which motor cars are prominent.

The main trouble arises from the fact that a ship designed to carry bulk cargoes like coal or grain needs deep holds, while small units, including cars, tractors and machinery of all kinds, need several 'tween decks and it has not been possible, in the past, to have a ship providing both types of space stowage.

This has now been accomplished using the Mezzo system of hinged panels which, when they are vertical, form a fore and aft bulkhead which prevents grain from shifting in the deep holds, and when horizontal, form an extra deck splitting the holds into two 'tween decks.

The ship can be transformed in a few hours from a deep-hold ship to one having 'tween decks, while, if necessary, part of the ship may have deep holds and rest several 'tween decks so that cargoes of grain and motor cars may be carried simultaneously in different parts of the ship.

This invention avoids the need to case export cars in wooden boxes, which must be done when they are stacked in a deep hold, and saves both expense and the use of timber whose import has been and still is very limited. The panels may be made in steel, but proposals have been made to use aluminium alloy so that they may be handled more easily, for example the panels required for a 10,000 tons deadweight ship, will weigh only some 8 or 9-cwts. each.

The applications of the new system do not stop here. Many cargo liner companies may wish to build ships with the same number of decks as in their previous designs, but with the lowest deck of the Mezzo type, thus making the new vessels much more suitable for part cargoes of bulk goods. In a three-deck ship, with the third deck on the Mezzo system, for example, two holds could be arranged to give two 'tween decks and a shallow hold, while the remaining cargo spaces might have a single 'tween deck and a deep hold. Even closer subdivision could be given by having part of a hold arranged with the Mezzo deck in the horizontal position, the remainder of the cargo space being normal hold depth to take, for example, a double deck bus.

While the invention is of importance in peace time as it increases the deck space by from 40 to 70 per cent, the ship still being capable of carrying grain when required, it will be of even greater value in wartime as all types of military vehicles may be carried uncased and ready for action. At the same time, when the tanks, trucks, etc., are unloaded, the ship is ready within a few hours to be diverted to grain producing countries for bringing back food to Britain. The extra deck is also useful for temporary troop decks.

It is understood that the cost of fitting the Mezzo deck can be recovered from the increased earnings of one voyage. The inventors are Mr. W. Stanley Hinde, a London shipowner, and Mr. Ronald Kendall, a naval architect and Editor of " The Shipping World " in London. Valuable assistance has been given by Dr. I. G. Slater, M.Sc., Ph.D., until recently Director of Operational Research, the Admiralty.

Pakistan's Port Development and Civil Engineering Requirements

Report of Mission from United Kingdom

In January, 1950, the United Kingdom Government accepted the invitation of the Pakistan Government to send an Industrial Mission to Pakistan. The mission, which consisted of eight members under the chairmanship of Lord Burghley, was given the following terms of reference: "To explore and report to the United Kingdom Government on the steps which might be taken to assist the flow of trade in both directions between the United Kingdom and Pakistan, and particularly on the ways in which the United Kingdom industrial and commercial interests could assist further in the planning and execution of schemes which the Pakistan Government have under consideration for the economic development of their country and the expansion of its trade."

Their report, which was published last September by H.M. Stationery Office (price 7s.), points out that after partition in August, 1947, Pakistan was left with the most important part of the major cash crops of the sub-continent of India—jute and cotton—while the factories for processing these raw materials were situated in what is now the Indian Union. The country was and is fortunate in her food and grain position, since there is, in a normal year, a surplus of wheat in West Pakistan, and nearly a sufficiency of rice in East Pakistan. She is determined to diversify her economy and to improve the standard of living of her people, and to do this the Government of Pakistan consider that the development of industry is essential, and intend to achieve this objective as quickly as possible.

The section of the report covering communications and transport, says that a well-planned network of communications and efficient systems of transportation are of primary importance for the commercial and industrial development of the country.

INLAND WATERWAYS

Dealing with the inland waterways, the report states that it is generally accepted, in considering the economics of transportation, that mineral or heavy traffic and long hauls are railway propositions, light and short hauls are for motor vehicles, but the cheapest overall form of transport is by water. East Pakistan is fortunate in having numerous navigable rivers, canals and waterways, and they play an important part in the life and economy of the country. The country craft from the upper reaches of the small rivers and outlying villages serve as feeders to the steamer companies and railways. The joint steamer companies (the River Steam Navigation Company and the Indian General Navigation Company), who have rendered great services in the movement of goods, are in process of enlarging their fleets and acquiring more vessels capable of crossing the Bay of Bengal in the monsoon season. In addition, in order to carry materials—principally jute—from various ports on the rivers to the Port of Chittagong, the Pakistan Government have acquired a fleet of tugs and barges capable of making the open sea crossing. This flotilla, which the Mission understands comprises:

11 Diesel tugs	320/700 h.p. each
4 Diesel dispatch boats ...	120 h.p. each
32-400 ton steel lighters	
1 fully equipped floating workshop.	

had not arrived at the time of their visit, but it was understood to be on the way from Manila. The addition of these craft is expected by the authorities to make a valuable contribution to the handling of goods at Chittagong and to help to relieve the congestion in the port.

Additional facilities in the form of slipways, small dry docks and further marine craft, etc., will no doubt be required and could be constructed and equipped by British contractors in co-operation with the Pakistan Government's Consulting Engineers.

PORT FACILITIES

In West Pakistan, Karachi with a rapidly increasing population, which since Partition has grown from 300,000 to 1,000,000, has become important strategically and politically as the Capital City. It has an international airport on the main route to the Far East and the Australian Continent, is the terminus of the North-Western Railway system, and a port of call on the sea route to the East.

The port was developed over a period of many years to serve the whole of North-West India (old style), and it was used extensively during the 1939-1945 war. Although, after an initial drop, the volume of traffic has increased since Partition, its capacity is still well in excess of the requirements of West Pakistan only. There are in existence twenty-one berths and numerous moorings and the port is well equipped for dealing with all the traffic likely to develop during the next few years. There are, however, no facilities for dry docking ships, and a scheme for a new dry dock and fitting-out berth has been prepared by the Consulting Engineers, Messrs. Rendel, Palmer and Tritton, and apart from the new dry dock and fitting-out berth, and perhaps the reconstruction of some of the older wharves, there does not appear to be need for further development at Karachi at the present time.

In East Bengal, Chittagong, with a population of 200,000—an increase of about 100 per cent. since Partition—has, in contrast to Karachi, great need for immediate expansion and development as a sea and air port and rail terminus.

The volume of traffic passing through the port at the time of Partition approximated to some 500,000 tons per annum, and at the time of the Mission's visit, with additional wharves which have been hurriedly constructed and are of a temporary nature, the traffic has increased threefold to about 1,500,000 tons per annum.

The traffic of the port, where at present imports are in excess of exports, is handled partly by rail and partly by water—in the approximate ratio of 2 to 1—by direct off-loading with light cranes, ship's tackle alongside wharves and by lighterage. The wharf-cranes and other equipment for unloading and loading cargo are inefficient and inadequate for the volume of traffic. The Government have therefore acquired a flotilla of river craft, to which reference has already been made, to deal with the water-borne traffic and the rail traffic from the western half of East Pakistan and thus to relieve the congestion of the port.

A long-term plan for the development of the port has been prepared by the Consulting Engineers to the Port Commission, which they consider will bring the handling capacity of the port up to 3,000,000 tons per annum.

This programme provides for an eighteen-berth port and includes the following:—

(1) Construction of eight new cargo berths.
(2) Construction of one passenger ship berth.
(3) Reconstruction of four existing berths.
(4) Construction of two salt golas.
(5) Construction of four lighterage jetties.
(6) Construction of ten transit sheds.
(7) Construction of ten warehouses.
(8) Construction of ten export sheds.
(9) Dockside cranes, wharfage and haulage equipment.
(10) Railway yards, marshalling sidings, storage sites, roads, bridges, a port colony, lighting, power, water, and other services, etc.

It must be emphasised that this is essentially a long term plan and that no early improvement will result from embarking on this extensive programme. It is suggested, therefore, that the immediate provision of other facilities, such as improving the access roads and railways serving the temporary wharves, completing the railway yards and marshalling sidings, building additional godowns and the unified control by the port of all traffic within its boundaries will, in a short space of time, further increase the present handling capacity of the port.

The safety and maintenance of the navigation channels in the river are of paramount importance; at the time of the Mission's visit, work on the training embankments had been suspended owing to lack of stone. The Mission suggests that the river training work should not be neglected, and that it should be proceeded with continuously. The possibility of opening up quarries in the region of Chakdarra on the Karnaphuli River might be explored.

Pakistan's Port Development and Civil Engineering Requirements—continued

SUMMARY

The following are the main conclusions:—

(1) That British suppliers and contractors can assist in the provision of marine craft and the construction and equipment of slipways, small dry docks, etc., required for inland navigation.

(2) That no immediate development or expansion appears to be necessary at the Port of Karachi.

(3) That every effort should continue to be made for the quick development of the Port of Chittagong by providing stop-gap facilities in the form of speedy improvement of road and rail access to the quayside, early completion of railway yards and marshalling sidings, the construction of additional godowns, and unified control of all traffic within the port.

(4) That the safety and maintenance of the navigation channels leading to Chittagong should be regarded as of the very highest importance and that determined efforts should be made to complete the construction of the training banks as quickly as possible.

CIVIL ENGINEERING AND BUILDING

The Mission assessed the total expenditure required to fulfil the Government's Development Plan over the next five years to meet all the schemes—civil engineering, building, agriculture, plant, machinery, etc., at some £200,000,000.

The primary allocation is as follows:—

A. Plant and Machinery—estimated expenditure £80,000,000.

B. Civil Engineering and Building—estimated expenditure £70,000,000, most of which will be spent in Pakistan.

C. Other Miscellaneous Expenditure—estimated at £50,000,000, part of which will be spent in Pakistan and part abroad.

It will be seen that if British consulting engineers, contractors and manufacturers have a contribution to make in the power development plans for West and East Pakistan, they have an even greater opportunity in the general industrial development plans and other large schemes outlined above.

Whilst the task which the Pakistan Government has set itself in its Development Plan is not excessive for a country with a long-established administration, it will undoubtedly prove difficult of execution in the stated time where a new organisation is being built up and men have to be trained to the jobs during the development period.

The ways in which the United Kingdom can make the greatest contribution to Pakistan's development in this field is to put at the disposal of Pakistan a proportion—small relative to our total capacity—of established constructional organisation built up in this country over a period of many years in the form of consulting engineers, architects, civil engineers and building contractors, and plant and machinery manufacturers.

The employment of this combination for constructional purposes would entirely relieve the Pakistan Government and officials of all the preoccupation of the engineering work during the period of construction and thus enable them to concentrate on the building-up of the future organisation and the training of personnel for operational purposes when the works are completed and handed over.

CIVIL ENGINEERING SCHEMES PROJECTED

In the General survey of West and East Pakistan the Mission visited the site of the following projects:

(a) The Warsak Hydro-Electric Scheme on the Kabu River in the N.W.F.P.

(b) The Mianwali Hydro-Electric Scheme on the Thal Main Line Upper Canal in the Punjab.

(c) The Karnaphuli Hydro-Electric Scheme at Chilardak on the Karnaphuli River in East Pakistan.

(d) The Chittagong Port Development Scheme in East Bengal.

(e) The Chittagong Town Planning Development Scheme.

(f) The Karachi Dry Dock and Fitting-out Berth.

(g) The Karachi Town Planning Development Scheme, Trading Estates and Steam Power Station Extentions.

The schemes enumerated above are works of considerable magnitude and involve an expenditure of about £50,000,000: consequently they represent a substantial part of the Pakistan Government's immediate plans for the development of the country.

When these projects are considered together with the industrialisation plans for the development of jute, paper, textiles, tanning, sugar, flour, fruit, etc., the ordnance factories, housing and buildings, the town services for sewerage, drainage, water supply, etc., it will be apparent that the Pakistan Government have set themselves a task of very great magnitude.

CIVIL ENGINEERING SCHEMES IN EXECUTION

In addition to the above projects, the Mission also visited the sites of the following important works which, at the present time, are in all stages of construction, from early beginning to near completion.

The Rasul Hydro-Electric Scheme in Punjab—approximate cost £3,000,000.

The Rasul Tube-well Project—approximate cost £4,000,000.

The River Ravi Syphon in the Punjab—approximate cost of syphon and associated canals £7,000,000.

The Malakand Hydro-Electric Scheme—approximate cost £200,000.

The Dargai Hydro-Electric Scheme—approximate cost £2,000,000.

The Premier Sugar Mills near Mardan—approximate estimated cost £2,000,000, in the North-West Frontier Province.

The Ordnance Factory at Wah—approximate estimated cost of barrage and canals £15,000,000.

The Lower Sind Barrabe at Kotri—approximate estimated cost of barrage and canals £15,000,000.

RECOMMENDATIONS

Proposing a system to overcome the problems arising from the rapid expansion under the Development Plan, the Mission suggests the setting up of a small Administrative Body in London which would act in liaison with the Pakistan Development Board in Karachi. It also suggested that the existing Development Board might be formed, to ensure continuity, on a permanent basis, with the political heads as ex-officio members, besides representatives of commerce and industry.

The Administrative Body in the United Kingdom would deal with organisation, progress and co-ordination and might consist of a Director, Deputy Director, Civil, Electrical and Mechanical Engineers, an Accountant and Assistants with a secretariat.

Its duty, when any new scheme is approved by the Government, would be to appoint consulting engineers with specialised knowledge and experience in the type of work to be undertaken. The consulting engineers would be paid on the usual basis calculated on the total value of the work. The engineers in turn would nominate a civil engineering contractor who would enter into a contract on the specifications, drawings and bills of quantities prepared by the engineers on a target estimate basis with an agreed percentage for profit, a bonus for saving in time and cost and a penalty for delays and extra cost. The necessary incentives would thus be provided for the contractors to complete the work efficiently and economically in the shortest possible time and guarantees given to the Government that under the supervision and guidance of the consulting engineers the materials and workmanship would be of the highest order.

The consulting engineers would also obtain quotations for the supply and delivery of the various plant and machinery and, after analysis and approval by the organising body, place the order and follow up the stages of manufacture and progress, thus co-ordinating the time of the construction work and avoiding delays and other difficulties.

The large numbers of administrative staff and personnel who will be engaged in these works during the next five years will make a valuable contribution to the training of Pakistanis until they are in a position to undertake these works by themselves.

Some of the advantages to be derived from the operation of this system are as follows:

Pakistan's Port Development and Civil Engineering Requirements—continued

(a) Delays in manufacture, supply of machinery and equipment during construction would be minimised or eliminated altogether.
(b) The time occupied—usually at least six months—as well as unnecessary expenditure involved, in preparing documents for a competitive tender, obtaining tenders, analysing and reporting would be saved.
(c) Works would be economically designed by experienced consulting engineers.
(d) Workmanship and materials would be of the highest order under the supervision of the consulting engineer.
(e) Contractors of repute with the necessary experience, organisation and plant would be selected to carry out the work successfully.
(f) Work would be executed economically in the shortest possible time.

As an alternative to the system proposed, there are a few organisations in the United Kingdom which, under a consortium of administration, engineers, civil engineering and building contractors, together with groups of manufacturers and engineering firms, are prepared to undertake complete projects from the inception of the scheme to final completion, including preliminary surveys, designs and the supervision and execution of construction.

The consortium arrangements might with advantage be used for specific schemes which the Pakistan Government may have under consideration without affecting the general application of the contract system as already outlined.

Loading Vehicles at Docks

Description of New Car Lifting Gear

Modern motor cars cannot be satisfactorily loaded and unloaded at docks by the use of net gear for these reasons:—

(1) The spreader and net system requires great care and close supervision to ensure the effective use of pads to keep the nets clear of the car's bodywork. The enormously increased volume of motor car exports makes it impossible for the same supervision and care to be exercised as was the case before the war.

(2) Modern car design tends to extend the wings more and more over the wheels and to make the wings an integral part of the bodywork. Damage to the wings is thus more likely, indeed, almost inevitable when nets are used, and repair much more difficult and costly.

(3) The use of nets also exposes cars to the danger of all the weight being thrown unevenly on the wheels on one side, resulting in severe stress and often in permanent damage.

To solve this problem, the Furness Car-Lifting Gear has been specially designed by the Stevedoring Department of Furness, Withy & Co., Ltd., Surrey Commercial Docks, London. It has passed exhaustive tests without a single failure and is already giving good service in the London Docks. It has no parts which require assembly or dismantling with each car and so is practically foolproof. Once rigged on the purchase it needs no adjustment until the last vehicle is loaded or discharged.

No damage to the bodywork can result from its use as the only points of contact are on the tyres; yet the car is subjected at no stage to any greater strain than when standing on all four wheels on the ground.

A common source of damage with ordinary lifting gear arises from winch and crane drivers lowering the gear on to the car awaiting handling. The Furness gear by its design obviates this, since it has to be placed on the ground under the plumb of the ship's purchase or crane, clear of the car, which is then pushed into position on it.

In designing stevedores' gear, simplicity of operation is the first consideration. Nothing could be more simple than this gear, which will automatically accommodate almost every make of car in the world's export markets, from the largest to the smallest. Adjustable flaps have been incorporated so that the frames will fit all usual diameters of wheels, even if the tyres are deflated, without the gear coming into contact with any part of the chassis or bodywork. These flaps also act as ramps to facilitate placing cars on to the frames. A flick of the foot then adjusts the flaps, and the car is ready for hoisting immediately. Its extreme overall width is only 7-ft. 6-in., making it easy to use when loading or discharging cars with only one section of hatches clear. When working with very small clearances and the smaller types of car it is possible to reduce the operative width of the gear to 6-ft. 9-in., by dispensing with the lateral, or athwartship wooden spreaders and the rope suspension gear will still clear the bodywork.

Its height in use has also been reduced to the minimum commensurate with safety, to enable it to be used where lift is restricted, and it will be found easy to use on vessels with almost the shortest of derricks, without undue strain on guys, especially when using " union purchase," or " married fall " types of gear.

The other important requirement of low and easy maintenance has also been met. Fair wear and tear on the frames, even with constant use, is negligible. Any part of the suspension gear can be easily repaired or replaced in any part of the world, since this gear consists of ordinary three strand rope and wooden spreaders.

Each frame is certified for a safe working load of 1 ton 5 cwt., making 2 tons 10 cwt. per set. Tests are made under actual working conditions to twice the working load, so that there is an ample safety margin for the heaviest of cars.

Car-Lifting Gear Frame in Tubular Steel supplied by Tubewrights Ltd. for Furness, Withy Ltd.

The complete gear consists of two welded tubular steel frames, which are suspended by eight ropes (connected by shackles to the ends of the main frame members) terminating in four main suspension ropes held at the correct angles by wooden spreaders.

The four spreaders on the suspension gear are made of wood. Two run length wise to the car and are retained on the ropes by the splices. The other two run crosswise acting as distance pieces, and have wedge-shaped slots so that they are held in position by friction and the weight of the gear.

As an added precaution against damage to the car, the lateral spreaders are padded on the undersides.

Each frame is made up of two longitudinal tubes, 6-ft. 9-in. long spaced apart by four lateral tubes, which form two rectangles in which the two wheels of one end of the car rest. On the main tubes, between the cross members, are pivoted flaps, which can rest on the cross members or be turned outwards to form ramps, when their movement is limited by stop studs.

The whole gear can be packed away in a space measuring 8-ft. 6-in. x 2-ft. 6-in. x 2-ft.

Underwater Protection of Steel

Investigations of New Anti-Corrosion Compositions and Effect of Surface Preparation

In 1946 the Marine Corrosion Sub-Committee of the British Iron and Steel Research Association, set up the Anti-Corrosion Compositions Joint Technical Panel, and since February, 1949, this Sub-Committee has been merged with that of the Protective Coatings Sub-Committee, under a new designation " Joint Technical Panel N/P2—Paints for Underwater Service on Steel." Now represented on the Panel, in addition to members of Protective Coatings Sub-Committee, are the Admiralty Corrosion Committee, the Association of Ships' Compositions Manufacturers, and the British Shipbuilding Research Association.

The Panel was constituted for the purpose of organising and conducting researches into the development of compositions for the protection of steel, and in particular ships' bottoms, against corrosion by sea water, and has recently published its first Report giving the details of the experimental work carried out, the results obtained and the conclusions arrived at. The Report can be obtained from The British Iron and Steel Research Association, 11, Park Lane, London, W.1, free of charge.

As a first step, the earlier work of the Marine Corrosion Sub-Committee was extended by following up the work of Fancutt and Hudson* on anti-corrosive compositions with an investigation of new formulations, designed to combine the advantages of two of the most promising compositions developed in that work. This included a study of the effect on performance of small variations in their pigmentation and the use of alternative vehicles.

Twenty-five pigmentations bound in each of two media, (A) phenolformaldehyde/stand oil, and, (B) Coumarone/stand oil, were investigated. Three of these pigmentations were also tested bound in each of several special media, including chlorinated rubber, dehydrated castor oil, modifications of Medium (A) and two other media, together with tung oil variations in Medium (A).

The protective properties of the compositions were tested under natural conditions in the sea at Caernarvon and Emsworth, as well as by accelerated artificial conditions at the Chemical Research Laboratory, Teddington, using the high-speed rotor apparatus developed there.

The Report describes the results of each test and gives a detailed explanation of the method of evaluating the results, the outstanding feature of which is the performance of the compositions in the special media. The chlorinated rubber medium has again proved to be the best, in conformity with earlier observations, but four modifications of the original Medium A have each given better results than either of the two media (A and B) in which the full range of pigmentations was studied. The effect of pigmentation has been less marked, but the indication is that an increase in aluminium content improves the protective properties of the compositions.

It appears that the most promising of the new compositions from all points of view is that numbered 655, which is pigmented with a mixture of two parts of basic lead sulphate and 1 part, of each, of aluminium powder, Burntisland red and barytes, and bound in Medium K1—a modified phenol-formaldehyde/stand oil/tung oil medium, in which the ratio of oils is 1:1.

A subsidiary series of tests, designed to study a method of preparing, for test, specimens with reproducible amounts of intact millscale on their surface, prior to coating with composition, is described but further research work appears to be necessary for the purpose of developing a standard surface preparation for steel specimens used for trials such as these. The preparations of specimens by simple exposure to the weather gives erratic results in this respect.

The report concludes with a Summary of Service Tests, on the Outer Bottom of Ships, which have been executed to date on behalf of the Marine Corrosion Sub-Committee, and states that detailed reports on the results of these tests will be published later.

Meanwhile, in addition to the Report referred to above, a paper entitled " Performance of Anti-Corrosive Compositions in Sea Water " has been published by Dr. J. C. Hudson in the July issue of the Journal of the Iron and Steel Institute. This paper presents and discusses the results of the Marine Corrosion Sub-Committee researches, but the views expressed are the author's and are not necessarily endorsed by the Sub-Committee as a body. A synopsis of the paper is as follows:

" The Marine Corrosion Sub-Committee's researches show that different methods of surface preparation have a marked effect on the performance on anti-corrosive compositions in sea water.

Paint gives poor protection against exposure to sea water if applied over millscale. Since, however, some paints fail to adhere to a completely descaled, freshly prepared, and unrusted steel surface it is recommended that the descaled steel surface be allowed to rust slightly or be treated with phosphoric acid wash before the application of the priming coat of anti-corrosive composition. In the case of ship's hulls, weathering the steel plates until they have shed their millscale completely should therefore yield good results. In practice it is difficult to ensure complete descaling of all component plates of the ship's bottom, and descaling of the plates by grit-blasting or by pickling, followed by a short weathering period or treatment with a surface wash is recommended.

Rates of pitting up 0.16-in./yr. have been observed at " holidays " (bare areas in a paint film) on an immersed steel plate. The presence of intact millscale beneath the paint may also promote pitting, but if about 90 per cent of this is removed by weathering, pitting will probably be no more severe than when the millscale is removed by pickling. The procedure of launching a ship with the bottom unpainted is not recommended because owing to the slower removal of millscale, pitting may result: it is also difficult to clean the surface before painting.

With a few exceptions, the relative behaviour of a given set of bottom painting schemes is the same whether applied to new specimens of unpainted steel or to specimens which have previously been painted and exposed to an immersion test. This applies in the main to both the protective and anti-fouling properties of the painting schemes.

Formulated anti-corrosion compositions developed by the Marine Corrosion Sub-Committee give good results as priming paints under a bottom painting scheme.* A mixed red lead and white lead paint in linseed oil is less satisfactory, although much better than a red iron-oxide paint in linseed oil.

Zinc or aluminium coatings on steel improve the performance of the bottom painting schemes applied over them; lead, however, promotes pitting.

Results of a raft test and those of a patch-painting trial are in good agreement.

*F. Fancutt and J. C. Hudson, "The Formulation of Anti-Corrosive Composition for Ships' Bottoms and Underwater Service on Steel"; Part I, J. Iron & Steel Institute, 1944, 150, p. 269p.; Part II, J. Iron & Steel Institute, 1946, 154, p. 273p.

Port of Aberdeen

Further Visit of Docks Executive

In the light of the evidence presented to them when they made an inspection of Aberdeen port facilities in April, 1949, the Docks and Inland Waterways Executive recommended to the British Transport Commission that from the point of view of future efficiency more permanent arrangements should be made for the administration of the port. The British Transport Commission has concurred in this recommendation and has requested the Executive to undertake consultations in connection with the preparation of a scheme for this purpose in accordance with section 66 (3) of the Transport Act which provides that a scheme may be prepared in consultation with the harbour authority concerned and with the representatives of shipping and traders actually using and workers actually employed in the harbour to which the scheme is to relate. Members of the Docks and Inland Waterways Executive are accordingly visiting Aberdeen on November 15 and 16 and are arranging to meet the various interests involved.

Winter Navigation on the St. Lawrence

A Suggested Method of Overcoming the Limitations due to Ice

By J. G. G. KERRY, M.E.I.C.

INTRODUCTION

IN this discussion the St. Lawrence Waterway is considered to extend from Port aux Basques, near Cape Ray in Newfoundland to Main Duck Island in Lake Ontario, a distance of some 950 statute miles.

Port aux Basques is selected as one terminal of the waterway because it is open to ocean traffic all year round except occasionally for a spell of a very few days when the Gulf ice is being swept out to sea in Spring. There are many years when the strait leading into Port aux Basques is never completely blocked by ice. The second terminal, Main Duck Island, is on the extreme eastern edge of the main deeps of Lake Ontario. Over these deeps the lake does not freeze at any time in the year.

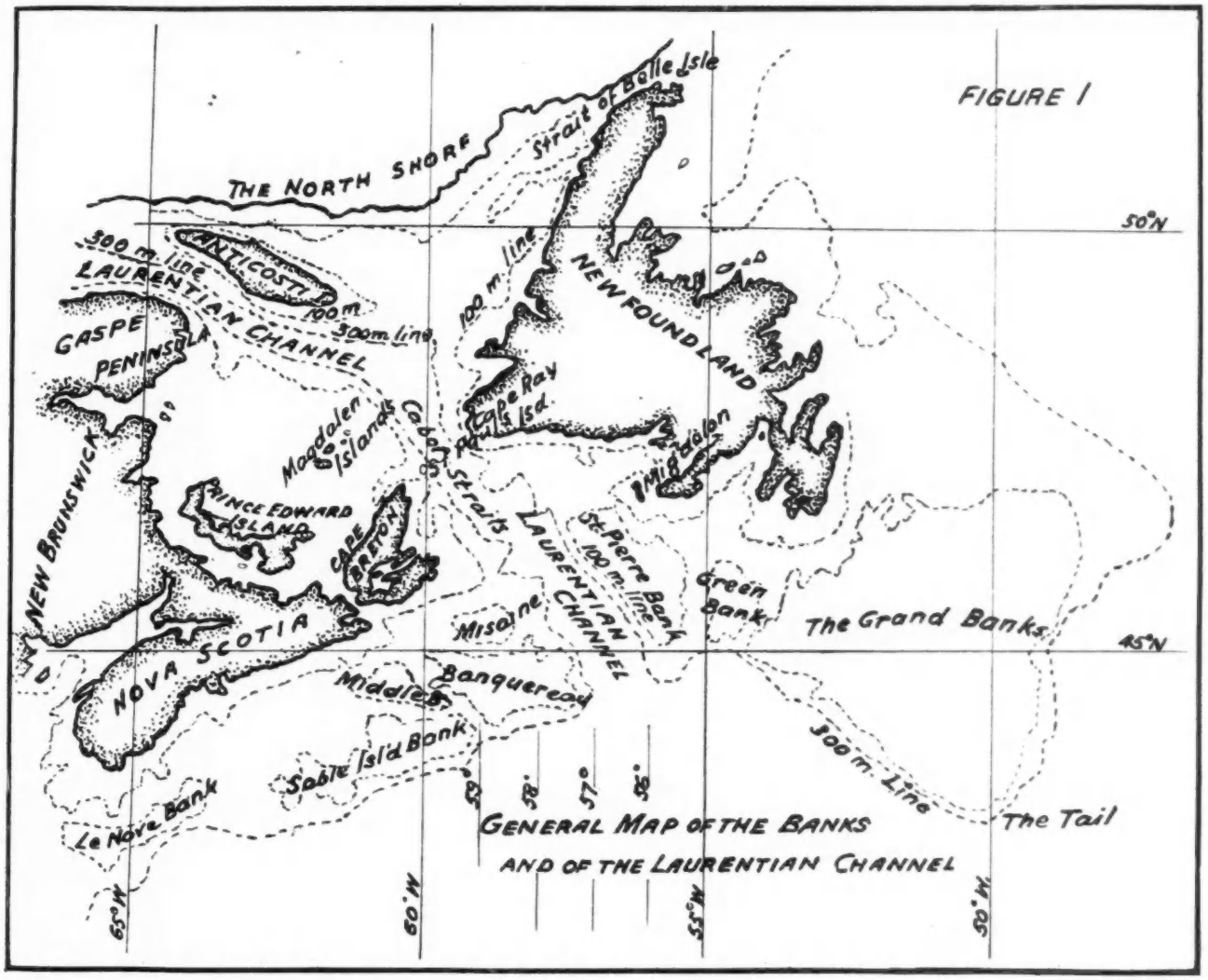
In this study the following sub-divisions of the channel have been made and each is discussed separately, viz.:—

(1) The entrance channel leading to Port aux Basques.
(2) The lower section of the Gulf of St. Lawrence and the "middle pack."
(3) The upper section of the Gulf ending at the mouth of the Saguenay River.
(4) The Estuary proper.
(5) Quebec to Ile aux Coudres.
(6) The fresh water section extending from Lake Ontario to Ile aux Coudres.

THE PORT AUX BASQUE CHANNEL

ICE PATROLS.

Between Port aux Basques and the open ocean there are always to be found in Winter and Spring two great areas of drift ice whose boundaries are always changing. During each spring the boundaries of these two major floes are under constant observation by the International Ice Patrol and by the Canadian Ice Information Service. These two bureaux work together as a team for the protection of all passing vessels to which a continuous series of warnings is communicated by radio. It is the boast of the International Ice Patrol that no serious shipwreck due to ice brought down by the Labrador Current has occurred since the Patrol was



Winter Navigation on the St. Lawrence—continued

established some thirty-five years ago. The Canadian Aeroplane Service has been in operation for about ten years and during that period no vessel entering the Gulf of St. Lawrence under direction of the Service has experienced ice difficulty. The International Ice Patrol watches the movements of ice and icebergs over and around the Grand Banks of Newfoundland and the Canadian Service studies how the ice moves as it drifts out of the Gulf of St. Lawrence through the Cabot Straits to its place of final disappearance in the seas off the south-east coasts of Cape Breton and Nova Scotia. The accompanying map (Fig. 1) shows the positions of the Coasts of Newfoundland and Nova Scotia and of the deep water contours in their vicinity.

MOVEMENT OF ICE.

It is a noteworthy fact that the two vast movements of the ice, caused respectively by the Labrador Current and by the Gaspe Current flowing out of Gulf of St. Lawrence, although they pass relatively so close to each other always distinct and separate and

Surface and Frazil Ice in the St. Lawrence River.

always there is open water between them. The map (Fig. 1) shows that a very deep and broad Channel, generally known as the Laurentian Channel separates the Grand Banks from the banks lying to the South-East of Cape Breton Island. Up this channel flows a powerful and relatively warm current of water originating probably from the area in which the waters of the Labrador Current collide with those of the Gulf Stream, this place being marked by the so-called temperature wall where the water temperatures of the ocean are found to change by many degrees in a ship's length. This westerly warm current aids in preventing the Labrador waters and the ice that they sweep along with them from making headway westward along the south coast of Newfoundland and at the same time it prevents the St. Lawrence ice from moving eastward from the edge of the banks that lie to the immediate south-east of Cape Breton Island.

The Labrador ice appears on the Grand Banks about the end of January and spreads all over them being most in evidence during the month of February and then slowly receding northward. Usually it gives but little trouble after the month of May save for the presence of individual icebergs which may call for watchfulness on the part of the International Ice Patrol until well into July. Labrador ice is not known to work westward beyond the Islands of St. Pierre and Miquelon nor to cross the line of the 57th meridian of West Longitude, the tendency of the whole pack being to move off south-easterly towards the Tail of the Grand Banks which is located near the inter-section of the 50th meridian of West Longitude with the 43rd parallel of North Latitude; the the western edge of the pack follows somewhat closely the south-west slope of the Grand Banks and of their neighbours the St. Pierre and Green Banks.

The St. Lawrence pack begins to run out through the Cabot straits about the beginning of the year and is most active in March and April. This ice may remain in the waters around Cape Breton until well into May, but its movements that most seriously affect Gulf navigation are made in the latter part of March or the beginning of April. The eastern limit for this pack is found near the meridian 58°30′ of West Longitude and the edge of the pack usually swings off south-westerly from a corner near the 46th parallel of North Latitude. Usually the pack near Cape Ray keeps to the southern half of the Cabot Strait but on occasion its northern edge will reach the south shore of Newfoundland and block passage for a very few days.

If the above limits are marked on the map (Fig. 1) it will be seen that a very broad channel remains open between the two major ice packs heading right up the south coast of Newfoundland. The lane then turns westward along the south coast of Newfoundland and rounding Cape Ray may be traced as far north as the Bay of Islands on the west coast of Newfoundland. If under the guidance of the Canadian Ice Information Service there is at no time of the year serious risk to be taken by a vessel intending to make Port aux Basque a port of call.

THE LOWER SECTION OF THE GULF OF ST. LAWRENCE

West of Port aux Basques and west of the line of the west coasts of Newfoundland and Cape Breton lies the main body of the Gulf of St. Lawrence, but only that portion of it that is crossed by the Ship Track used during the spring months need be particularly discussed in this paper. This portion as shown on Fig. 2 covers the broad and very deep Laurentian Channel which runs between Cape Breton and Newfoundland and continues westward between Anticosti Island and the Gaspe Peninsula. This section may be considered to end towards the west at a line drawn from Fame Point to the west end of Anticosti Island. Hydrographically this section might otherwise be defined as that area of the Gulf waters that is limited by the line of the west flowing Laurentian current on the north and by the line of the east flowing Gaspe Current on the south. The volumes of these counter-balancing currents are roughly equal and they are of gigantic dimensions, each of them carrying about one hundred times as much water as the St. Lawrence River itself discharges.

WATER CURRENTS.

The Laurentian current comes up from the neighbourhood of the Grand Banks and after rounding Cape Ray swings northward and fans out, one finger following the west coast of Newfoundland, another heading into the Jacques Cartier Passage, but the great mass of this current after making a tremendous sweep to the northward crosses the line of Anticosti Island near Heatn Point and then follows the south shore of the Island westward. Its flow is often obscured by surface currents.

The Gaspe current flows with great strength parallel and close to the north shore of the Gaspe Peninsula. Reaching Cape Gaspe it makes a sweep to the south roughly paralleling, but a considerable distance away from the shores of Prince Edward Island and then finds its way back into the Cabot Straits through the gap between the Magdalen Islands and Cape Breton.

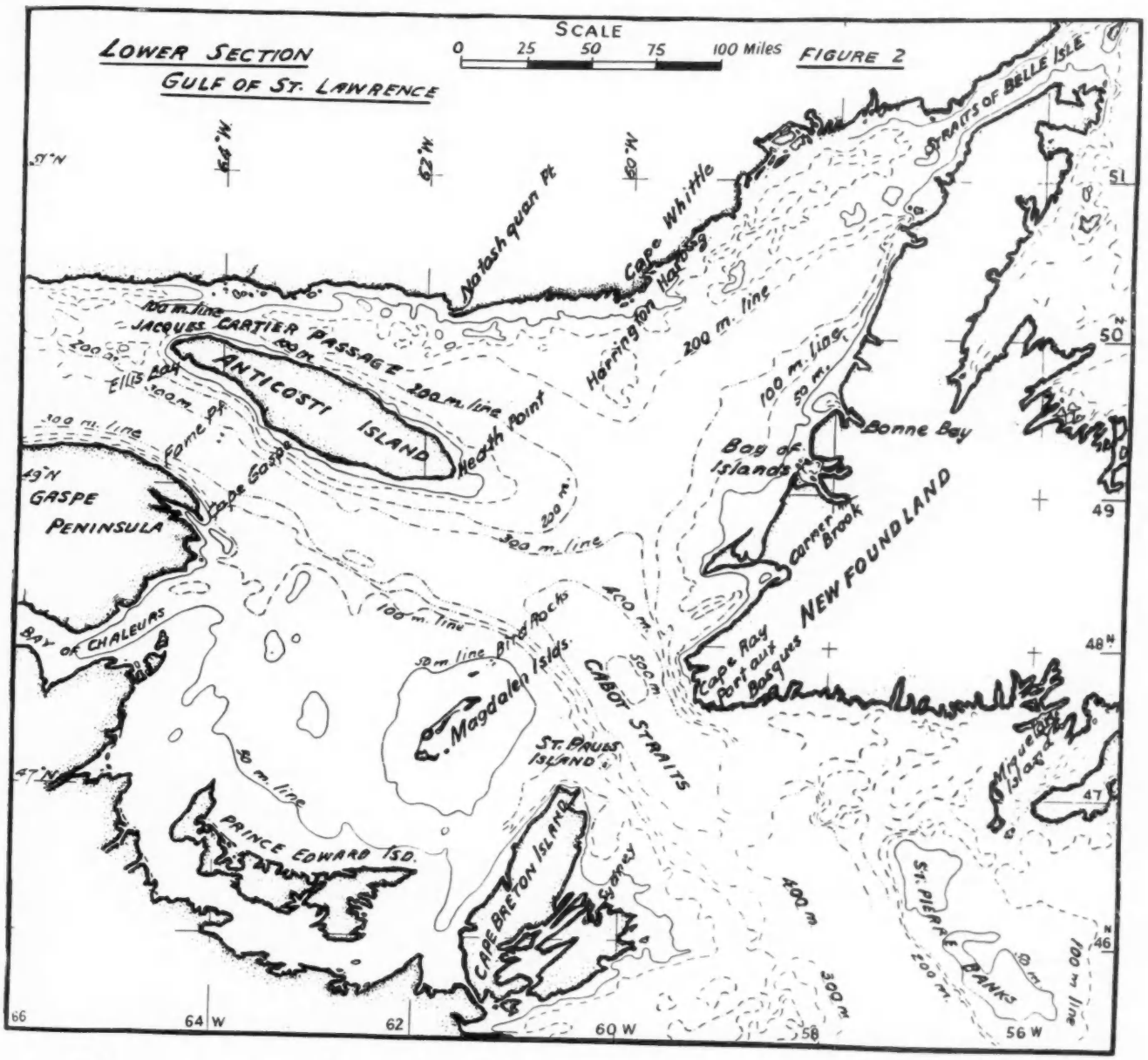
The area of waters lying between these two great currents is not sharply defined and has the shape of a very rough circle, it is free from any very dominating current and free from any serious tidal disturbances, the vertical range of the tides at the Magdalen Islands being but 3-ft. This area by measure will be in the neighbourhood of 30,000 square miles. Any ice floating into this area is quite likely to remain there until driven through the Cabot Straits by persistent and powerful winds. Actually this area becomes packed with drift ice by the beginning of February, a fact which is important for the Ship Track passing close to such stations as Fame Point, Heath Point, Bird Rocks, and Cape Ray has to cross this pack for a distance of over two hundred miles. This pack is usually considered to be impassable for ordinary sea-going vessels after the middle of January and until late in April.

The Laurentian Current carries little or no ice with it past Cape Ray, but the Gaspe Current is a very generous contributor of drift ice drawing much of its supplies in the early winter from the fresh water river between Ile aux Coudres and Three Rivers and later from the shoals along both the shores of the Gulf from the Ile aux Coudres to the eastern end of Anticosti Islands. Some additions to the pack come from the north-east arm of the Gulf; these are moved by prevailing winds and by the wide northward sweep

Winter Navigation on the St. Lawrence—continued

of the Laurentian Current. The pack itself is finally swept out through the Cabot Straits late in March or early in April after the Gaspe Current has ceased to bring down tribute and after the March sun and the westerly winds have had opportunity to work on the ice in it.

To make navigation across this section of the Gulf a reasonable undertaking in winter time it is clear that the point or points of origin of the drift ice must be determined and if possible the flow of this ice into the Gulf area must be cut off. Ice does not appear to form in large quantity along the Ship Track but the drift ice is



often close packed and it is continually shifting and moving. Some wastage of ice from the pack into and through the Cabot Straits is continuously taking place from the first days of the year and at times from an even earlier date.

FORMATION OF ICE.

When studying the rate of formation of sea water ice within the Gulf the physical constants of sea water and of sea water ice must be closely considered. In fresh water bodies, such as Lake Ontario, water is found to have a maximum density at a temperature of about 39° Fahr. and the density of the water slowly and somewhat regularly decreases with decrease of temperature until freezing point is reached at 32° Fahr. The surface water in cooling off becomes lighter than the waters beneath it and would tend to remain on the surface if it were not for the turbulence created in the waters by the winds that blow almost continuously over the Great Lakes in winter. This turbulence is steadily bringing warmer waters to the surface in spite of the slight adverse difference in the densities and the process in the Great Lakes continues until the whole body of the waters is cooled down to a temperature approaching 32° Fahr. But in fact in such lakes as Ontario and Michigan the winters are not long enough for this process to complete the cooling off of the waters and ice never forms over them except in bays and shallows or in the rare form of thin crusts appearing in cold still weather. Salt water on the other hand as met with in the Gulf does not commence to freeze until the surface waters have a temperature of about 28.5° Fahr and these waters grow continually heavier as their temperatures decrease right down to their temperature of freezing.

Winter Navigation on the St. Lawrence—continued

TEMPERATURE AND SALINITY.

In addition it is found by observation that there is some indication of a definite relation between temperature and density in the Gulf waters down to a depth of about 150-ft. For some unexplained reason the waters as they grow warmer appear to lose some of their salinity. Therefore both because of density and of salinity the waters as they are warmed by the sun and other surface influences tend to remain at the surface and in spring the surface waters of the Gulf are quickly warmed up in a rather thin layer, the temperature of which occasionally rises up to as high as 70° Fahr. in summer. This warm layer is very thin not generally exceeding about 30-ft. in depth in mid-summer and it is found all over the water surface of the Gulf. When cooling off in the autumn the surface waters as they grow colder are constantly growing heavier and sink and as they sink they seem to increase in salinity and grow still heavier. Thus a vertical circulation is set up which seems to be felt to depths at least as great as 150-ft. and the activity of this process is much aided by the tidal impulses and by the activity of the winds. Finally, all the warmer waters in the upper 150-ft. are cooled down to a uniform temperature of about 28.5° Fahr. and ice will commence to form. It is still doubtful when the waters in the main deep extending from Cape Ray to Red Islet opposite the mouth of the Saguenay River are cooled down to as low as 28.5° Fahr., that is, wherever the depth of the water exceeds say 150-ft. No records of temperature in the inflowing Laurentian Current opposite Cape Ray taken at dates later than the end of November are obtainable, but about that date these waters have a temperature of about 40° Fahr. for a depth of over 150-ft.

INFLUENCE OF CURRENTS.

The course followed by the Laurentian Current as it moves up-stream is not well known nor is the velocity of its flow, but in volume and speed it must closely approximate the volume and speed of the Gaspe Current, which have been closely observed, for the Gaspe Current carries carries out to sea the waters that the Laurentian Current brings in. On this assumption it is theoretically unlikely that the heat energy contained in the current as it passed Cape Ray and in the deeps of the Gulf itself would have entirely been dissipated by the time its waters have reach Red Inlet; also much water from the Laurentian Current will be found to have been turned back over a much shorter path and to have become part of the Gaspe Current long before any Laurentian waters have reached Red Islet. In other words no ice would be forming in the Gulf between Cape Ray and Red Islet except in shallow waters. This estimate is only true even in theory for the time period close to November 30th.

What the water temperatures are near Cape Ray in the winter months is not known, but it is known that the North Channel from the west end of Anticosti to Red Islet remains fairly clear of ice all winter long and that the Gaspe Current sweeping along the south shore although heavily laden with floating ice flows on like open water without check or hindrance. Furthermore the middle pack itself remains loose all winter long shifting and changing its position with every shift of the wind. These are all indications that ice is not forming rapidly in the Gulf waters during the winter months, of course ice will build up rapidly along shore lines and over shoals, but these are but a small portion of the total Gulf area.

ICE FORMATIONS.

It should be noted that when the time for the freeze-up comes ice should form more rapidly in salt water than in fresh for the latent heat of fusion for salt water ice although very variable with changes in salinity and temperature is usually much less than that for fresh water ice. However as a general conclusion and until further evidence is available it is not too unreasonable to conclude that the deep waters of the Gulf do not add as materially to the mass of ice in the middle pack as would be expected. In late winter, say after February 1st, it is quite likely that the whole body of water in the Gulf to a depth of over 150-ft. has been cooled down to freezing temperature and under favourable conditions ice will form rapidly. Such ice is broken up by wind and wave before it has time to thicken and finds its way with the aid of wind and current into the Gaspe Current and thence into the body of the middle pack.

The Bay of Chaleurs and the area north of Prince Edward Island freeze over at an early date for they are shallow, but the ice does not appear to obstruct the Ship Track. It forms solidly and breaks up late, ice breakers being regularly used to open up navigation in the Bay of Chaleurs; in moving out this south ice tends to pile up against the west shore of Cape Breton and to work out slowly around St. Paul's Island without blocking the northern half of the Cabot Straits. This is the last ice to disappear from the southern sections of the Gulf.

Ice formation in the north-east arm of the Gulf is somewhat complicated by inflow through the Straits of Belle Isle. Conditions in the Straits have been closely investigated during the months in which vessels are passing through and in general the currents in it have been found to be tidal currents. The volume of water transported through the Straits is then negligible, but the existence of " dominant " currents that may flow either inwards or outwards has been noted. These dominant currents will at times completely overcome the tidal currents and it is reported that they sometimes flow inwards for as much as a month at a time. There is an unproved theory that the Labrador Current flowing past the east end of the Straits is at maximum strength around mid-winter and at minimum strength around mid-summer, about which latter time all recorded studies of the currents in the Straits have been made.

EFFECT OF STRAITS OF BELLE ISLE.

It is customary to belittle the possible effect of the flow through the Straits of Belle Isle on the water temperatures in the Gulf, but if the existence of a dominant current during the early months of winter as swift say as the Gaspe Current is conceded it would carry into the Gulf vast quantitites of ice that has been formed along the Labrador shores. This ice is known to be moving southward after the end of November. Such a current could force a flow through the Straits perhaps half as great in volume as the calculated inflow through the Cabot Straits and could fill the north-east arm of the Gulf which has an area of about 10,000 sq. miles with the ice cold waters of the Labrador Current. If it be realised that these Labrador waters have a temperature of perhaps 29° Fahr. and that the waters entering the Gulf at Cape Ray have a temperature of 40° Fahr. at the end of November it will be realised that the winter inflow through the Straits of Belle Isle can have a very great influence on the formation of ice within the Gulf. Until thorough studies have been made of the currents flowing through the Straits of Belle Isle throughout the full round of the year that influence must remain a matter of conjecture. Such evidence as is available appears to justify the likening of the Straits of Belle Isle to a double acting pump whose function it is to lower the water temperatures in the north-east arm of the Gulf. Along the north shore of the Straits a current of varying strength sweeps in carrying with it waters from the Labrador Current whilst the balancing current along the south shore carries outwards the warmer waters of the Gulf. The north shore current is thought to be stronger and more persistent than the current along the south shore and the waters that it carries inwards appear to cling to the North Shore of the Gulf and to make their effect felt, particularly in summer, past Cape Whittle and into the Jacques Cartier Passage.

To close the Straits of Belle Isle against the influx and efflux of the waters would be a heavy undertaking as the volume of material to be handled would be great, but one that otherwise presents no unusual engineering difficulties.

LABRADOR ICE.

At the present time large quantities of Labrador ice are known to enter the Gulf through the Straits of Belle Isle during the early winter and some of this ice, aided by favourable winds and currents, finds its way into the " middle pack," but proportionately this contribution is not believed to be large. Unfortunately such ice with the accompanying floebergs and growlers provides the most formidable ice obstacles that a ship can run up against in the pack. The Labrador ice has been estimated to have an average thickness of about 7-ft., whereas Gulf ice when allowed

Winter Navigation on the St. Lawrence—continued

to freeze without disturbance throughout the winter will rarely have a thickness exceeding three to four feet.

Sheet ice forms fairly early in the cold waters of the north-east arm and these waters are usually completely closed by ice from the Bay of Island across to Cape Whittle early in February. During the break-up this northern ice remains generally stationary nor does it discharge itself through the Cabot Straits. It may therefore be disregarded in a study of ice conditions along the Ship Track in the early spring but the whole problem of the inflow and outflow of waters through the Straits of Belle Isle calls for critical study by competent observers. More than twenty years ago departmental officials in Ottawa predicted a complete change of climate along the North Shore and a complete freeing of the Ship Track from ice obstruction throughout the year if the Straits were to be closed. This recommendation still awaits further official study and action.

It is noteworthy that winter air temperatures at Harrington Harbour are practically the same as those at Quebec and at Gaspe. At mid-summer the air temperatures at Quebec and Gaspe are about 10° Fahr. above those at Harrington Harbour. The cold inflow through the Straits of Belle Isle must contribute in some measure to this change in the relative temperatures.

Also the distance from Corner Brook to Cape Whittle is a matter of only 100 miles, yet both in January and in July there is a temperature difference of some 10° Fahr. between the two shores. This difference must in part be due to the relatively high temperature of the waters entering the Gulf near Cape Ray and reaching the Bay of Islands as compared with the waters inflowing through the Straits of Belle Isle and reaching Harrington Harbour and Cape Whittle.

Ice Jam at Montreal Harbour.

FORMATION OF "MIDDLE PACK" ICE.

A glance at the map (Fig. 2) after consideration of the foregoing comments will indicate that the mass of the "middle pack" that lies across the Ship Track must come either from the growth of ice within the Gulf itself and along its shore or from contributions brought down to it by the Gaspe Current. The probability of ice forming in quantity within the Gulf itself has already been discussed.

It seems probable that a large amount of ice carried down by the Gaspe Current comes from the shallows and shoals that lie around Ile aux Coudres and from thence up the river as far as Three Rivers. An ice bridge usually forms across the river near the east end of Lake St. Peter about December 1st and after that date, but little drift ice originating west of Three Rivers will reach the Gulf.

In more recent years no ice bridge has been permitted to form between Quebec and Three Rivers, ice breakers being kept at work systematically to prevent any such formation. All these shallows and shoals are alike in that the water covering them is fresh or only slightly saline and they are regularly swept over twice a day by very powerful tides. This condition, particularly in the winter climate of Quebec, is most favourable to the rapid formation of ice and if it be assumed that each tide sweeps away any ice formed during the ebb of the preceding tide the formation of new ice at the rate of perhaps 6-in. per day is a possibility. These shoals have an area of about 600 sq. miles and as the Gaspe Current is said to move at an average speed of 2 knots and has an effective width of about 12 miles what might be termed the daily surface movement of the Gaspe Current is also about 600 sq. miles. The speed of the current varies with the stage of the tide, but it is always sweeping eastward and apparently the upper shoals can, in theory, make ice about as fast as the Gaspe Current can carry it away. It is not suggested that any such balance of supply and demand exists, but at its rate of flow the Gaspe Current could cover the area of the "middle pack" with up-river ice in about a month and a half; this latter figure is about in agreement with fact for the "middle pack" is always fairly well formed by the beginning of February.

PROPOSED BARRAGE AT ISLE AUX COUDRES.

As this active ice movement is largely due to tidal fluctuation it may be noted that a barrage across the Gulf of Ile aux Coudres with the assistance of levees could almost completely cut off the supply of drift ice to the Gulf areas from the upper shoals. Substantial quantities of drift ice might be expected to form in the Gulf itself after February 1st, but this ice would not be of great thickness nor would it be hard frozen if compared with drifted fresh water ice.

Speaking generally, the middle pack is always loose and in motion and can be readily penetrated by an ice breaker or a well built and well-powered ship unless that ship happened to encounter very heavy ice from the Belle Isle area, or were to enter the heavy pack that forms near to and around St. Pauls Island.

To some extent the ice floes from the different sources are distinguishable by their texture and a navigator working through the middle pack can say from what area the ice that he is encountering came from. Such men have estimated that if the ice floes from the fresh water sections of the river and from the Straits of Belle Isle were to be cut off the volume of drift ice in the middle pack would be cut down by 60 per cent. and the Ship Track from Cape Ray to Fame Point would become safely navigable at all times in the year. It is quite possible that systematic aeroplane surveys of the middle pack and of the ice roads leading to it if maintained for one or two winters would make it possible to roughly substantiate the accuracy of the above estimates. There is no question as to the beneficial effect of cutting off both the sources of ice supply that have been discussed above, it is only a question of the extent of that beneficial effect. It would appear that a prolonged and careful study of the sources of supply of the ice in the middle pack is fully justified by the known facts.

SUMMARY.

In resumé of the foregoing discussion it may be pointed out:

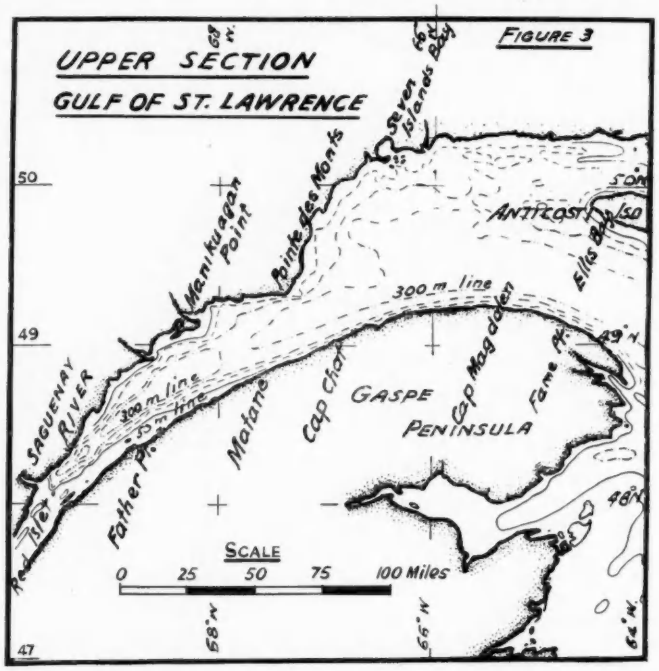
(1) Ice forms thick and hard in the Bay of Chaleurs and in the Bight of Prince Edward Island, but this ice breaks up late and finds its way to the ocean without blocking the Ship Track from Cape Ray to Fame Point.

(2) Ice from the north-east arm of the Gulf and from the Straits of Belle Ile finds its way into the pack blocking the Ship Track, but only in limited quantity. This contribution may, however, be in part of ice much heavier than the ice formed in the Gulf and therefore dangerous. The closing of the Straits of Belle Isle would keep out this dangerous ice and would reduce the quantity of ice actually formed in the Gulf, but the result as appearing in the extent of the main pack would be small. The waters along the North Shore would be warmer all year around and the formation of ice in the Jacques Cartier Passage would be checked to some extent.

(3) The cutting off of the up-river ice by a barrage near Ile aux. Coudres would greatly reduce the amount of drift ice in the Gaspe Current and in the main pack.

(4) There would still remain a large pack of Gulf ice which it is practically impossible to cut off, but the opinion of experienced sea captains is that navigation through the remaining pack would not be too difficult after the cut-off had been made especially if aided by the Ice Information Service.

Winter Navigation on the St. Lawrence—continued



It should be noted that the middle pack does not now extend far enough up-river to interfere with navigation between the Bay of Seven Islands and Quebec and the up-river ports. It seems likely that this navigation could be maintained all year around if the barrage at Ile aux Coudres were to be constructed.

UPPER SECTION OF THE GULF OF ST. LAWRENCE

CURRENTS.

The second section of the Gulf extending from the west end of Anticosti Island to Red Islet opposite the mouth of the Saguenay is notable for three great current systems, first the Laurentian Current which continues to work upstream in diminishing volume to a turn around point near Red Islet. This current keeps to the north side of the Gulf, but its presence is not sharply in evidence. Second: The cross-currents which are continually delivering Laurentian water across the Gulf to the Gaspe Current on its South Shore, and third, the Gaspe Current which originates close to Red Islet and flows close to the South Shore of the Gulf as far as Cape Gaspe.

TEMPERATURE AND SALINITY.

Knowledge of the changes in temperatures and salinities in these waters is quite limited as all recorded observations have been made in the four summer months.

From the Banks up as far as the mouth of the River Saguenay the waters in the deep channel show one and the same distribution of temperatures and salinites, as the weight of the waters varies with their salinities; these in fact help greatly to determine the definite stratification in the whole mass which appears to persist right up to the west end of the Gulf. The waters of lowest salinity are at the surface and the salinity increases more or less steadily with depth.

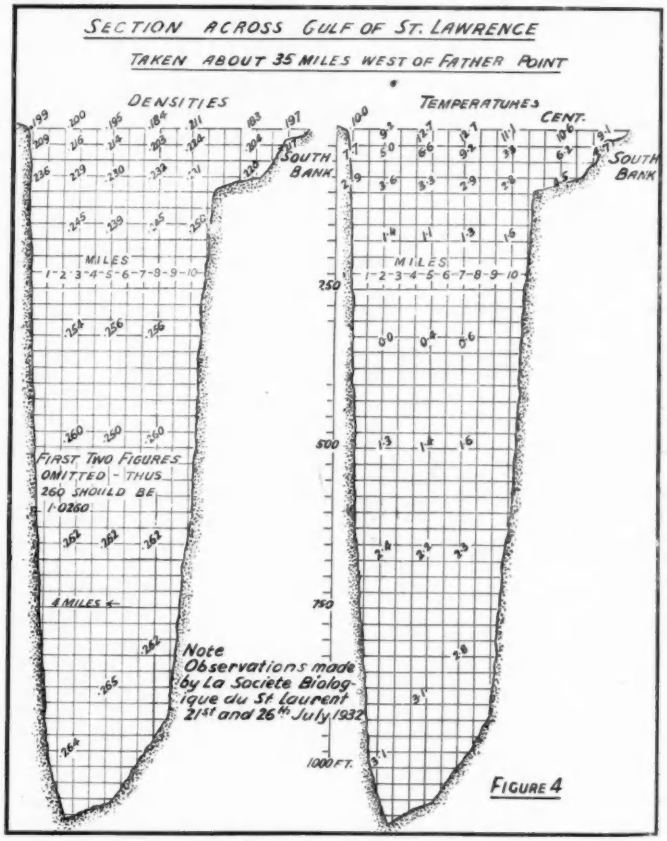
It is the same with the temperatures; there is an upper layer of about 150-ft. in thickness whose temperatures vary sharply with the season of the year being sometimes as high as 70° Fahr. at the surface in mid-summer. The temperatures of the upper layer around mid-winter are unknown as no systematic observations of water temperature in these areas have been made except in the summer months. The changes of temperature in this layer are not wholly a simple matter of season, the great flood sweeping in past Cape Ray has its own distinctive temperatures and there are no data that record its changes in temperature as it works its way upstream. But great as it is, this inflowing current is insignificant in volume when compared to the mass of the waters in the Gulf.

Below this upper layer there is found for a depth of about 150-ft. a second layer, but of ice cold water, the temperature of which may possibly change but very little throughout the year. This ice cold layer retains its place in every cross-section of the Gulf by virtue of its salinities and therefore of its weights. It is noteworthy that in both salinity and temperature this layer of water resembles very closely the waters—other than surface waters—of the Labrador Current. Beneath the cold layer and down to the bottom of the trough which is usually more than 1,000-ft. deep both the temperatures and salinities increase and the waters bear a close resemblance to the waters of the ocean itself. The accompanying Fig. 4 show a typical cross-section of the Gulf on which the changes with depth in summer of both temperature and salinity can be clearly seen.

Oceanographers are not agreed on the causes of this typical stratification nor as to the extent to which these waters are in motion. Such measurements as have been made deal generally with the waters only to depths that are important to the art of navigation but it has long been known that the cold water layer is forced up to the surface by the reefs that cross the Gulf near the mouth of the Saguenay River and it disappears from the cross-sections in that neighbourhood.

CURRENTS AND SALINITY.

It will be noted from the accompanying map (Fig. 3) that the Gulf from west end of Anticosti Island up to the mouth of the Saguenay River shows an almost continuous shrinkage in breadth and cross-section. It is thought that throughout this section of the Gulf and especially in the neighbourhood of Points des Monts the Laurentian waters flowing inward along the North Shore are progressively being carried across the Gulf to join the waters of the Gaspe Current the starting point of which is found to be near the junction of the lightly saline surface waters of the Saguenay River with the lightly saline surface waters of the main river. It is noteworthy that the influence of the River St. Lawrence itself on the salinities and temperatures of the Gulf waters can be traced down as far as the mouth of the Saguenay River. In this section



Winter Navigation on the St. Lawrence—continued

of the Gulf covering perhaps 11,000 sq. miles, the shoal areas do not cover more than from 600 to 700 sq. miles. It is difficult to estimate how rapidly ice will form over this area; the waters from the mouth of the Saguenay River down to the Bay of Seven Islands and to Ellis Bay, on Anticosti, are generally clear of ice along the north shore all winter long, a fact that is said to be due to persistent northerly winds and to the widespread cross-currents moving southerly across the Gulf and to the action of the Gaspe Current in sweeping away eastward all drift ice as quickly as it reaches it. Steamers ply all winter long from Pointe aux Pic to the Bay of Seven Islands, but their schedules have to be altered at times on account of ice movements caused by adverse winds and by exceptional weather. Cold clear weather after the beginning of February is fairly certain to be accompanied by the rapid formation of surface ice which the steamers must cut through.

In the nearby Saguenay River, also flowing in a very deep trough, ice begins to form rapidly about the end of November and grows to an ultimate thickness of perhaps 3-ft., but the surface waters of the Saguenay are only modestly saline and they are fairly free from the violent agitations that mark the movements of the tides up the main valley. As in the easterly portion of the Gulf it is questionable whether sea water ice forms in quantity below the mouth of the Saguenay River, the causes being the same as already discussed, viz.: the natural warmth of the water mass, the vertical circulations due to changes in temperature and salinities and the internal currents created by tides and winds.

The movements of the drift ice with changes in the direction of the winds are rapid and at times interfere with the schedules of the operating vessels but no systematic effort has yet been made as in the area around Cape Ray to see whether vessels could be guided across this portion of the Gulf at all times without ice interference. It seems certain that if the up-river ice were to be cut off by the suggested barrage near Ile aux Coudres that this section of the waterway would be almost clear of ice and navigation could be carried on without serious danger all winter long.

(To be continued)

Entry and Clearance Procedure at Ports

Simplification Sought by New Orleans Port Agency

By LEWIS I. BOURGEOIS
(Director of Commerce, Port of New Orleans).

In moving commerce through any port, the vast majority of shippers or consignees, forwarding agents or brokers, exporters or importers, seldom encounter difficulties. Despite the fact that many sevices must be performed at the port to comply with entry and clearance regulations of the countries to and from which the goods are being shipped, it is commonplace to hear said of this phase of shipping that " It is not difficult to engage in foreign trade."

Nevertheless, because no port can guarantee to its users complete immunity from the problems that arise occasionally from complex international trade practices, there has been established at the Port of New Orleans an agency whose special purpose is to facilitate the flow of consigned cargo to its destination.

This agency, the newly formed " Port Commerce Committee," is ready to lend every assistance within its province to the new shipper in foreign trade and to the old and experienced shipper seeking to facilitate the movement of his consigned goods.

The Committee studies every difficulty and complaint which comes to it and, after clearing, takes steps to prevent recurrence. Additionally, the Committee has undertaken the study of established procedures which tend to hamper the free flow of commerce, and will actively support their revision or correction.

Matters related to rates, rules and privileges of the inland carriers and the ocean lines, and to the actual transport of commerce, do not come within the functions of the Committee. Neither does the group, as such, concern itself with selling and promoting commerce movement: agencies qualified and performing that service are the railroads, barge lines, motor truck lines, the steamship companies, and the Port's commerce department. The Committee concerns itself with what happens after the shipment, whether import or export, has reached the Port.

What are some of the difficulties shipments encounter? To cite a few, here are several instances that have come to our attention: Quotas on a certain commodity had been established by a foreign country, but when the shipment reached this port, the exporter was confronted with a consular ruling that differed from the consular ruling given by his country's representative in another port.

At another port, a government agency was applying erroneous interpretations to export regulations, thus permitting shipments through that port to enjoy undue advantage.

At this port, freight forwarder fees, in special instances, appeared to be excessive and threatened to cause diversions; in another instance, payment of consular fees at a consulate was being required in a manner differing from the established practice, causing inconvenience.

Also encountered have been a variety of difficulties usually met with by importers not thoroughly familiar with customs regulations, tariffs, etc. In this connection, members of the Committee are urging early passage of H.B. 8304, Customs Simplification Bill, now pending in the Congress. This will mean a simplification of customs laws, permitting an easier understanding of governmental requirements, an assurance of consistency in tariff assessment, and a removal of technicalities in various directions.

In its desire to remove all barriers which discourage world commerce movements, the Committee has given its support to an appeal to a Latin American republic for a change in its regulations against the use of order-notify ocean bills of ladings. While no change has taken place as to these documents, there has been an improvement in that U.S. shippers will be given greater protection on their shipments made on sight-draft basis. Consequently, the Committee is continuing its efforts with the hope of obtaining further changes which will give the American exporter the same protection which he obtains on his order-notify shipments to other countries.

The Port Commerce Committee is made up of representatives of the New Orleans Chamber of Commerce, the New Orleans Board of Trade, International House, the New Orleans Export Managers Club, the New Orleans Steamship Association, the New Orleans Freight Forwarders' Association, and the Board of Commissioners of the Port of New Orleans.

The activities of the Committee represent an innovation in port community co-operation. All members serve voluntarily. The representative agencies are all deeply interested in a free and easy movement of port commerce, and all recognize the importance of eliminating any difficulty which would interfere with or hamper such movement. Already many users of the Port of New Orleans are aware of the functions of the Committee. Feeling assured that such a Committee is constantly on the alert to act in their interests, these shippers have given renewed expression of goodwill towards the Port and all of its several services. They see in the Committee a manifestation of genuine interest in their patronage.

The Committee has worked closely with the several consulates, the customs officials, the forwarders, the brokers, the carriers, the bonded warehousemen, and the many other interests which do business at the Port. It has received fine co-operation from every quarter, and thus has been able to aid not only the American importer or exporter, but also his customer overseas.

RECORD TRAFFIC THROUGH KIEL CANAL.

Traffic through the Kiel Canal during September last, reached a post-war record of 1,790,382 tons, an increase of 7.5 per cent over the August tonnage. A total of 3,670 vessels passed through the Canal, comprising 2,936 German, 356 Norwegian, 219 Danish and 159 Finnish.

The Maritime Ports of France

A Review of the Reconstruction Progress and Modern Technique

By R. R. MINIKIN
Chevalier de la Legion d'Honneur.

(continued from page 199)

The second volume of the issues of " Travaux,"* dedicated to the maritime ports of France, contains articles from the pens of the engineers who are responsible for the reconstruction of the ports on the Atlantic Coast from St. Malo to the basque fishing port of Port Vendres, and the Mediterranean Coast from Sete to Toulon. It also contains interesting articles on coastal navigational lighting; the development programmes of radio-electric navigational aids and telephonic communication. Last, but not least of the series, is the able summary of the modern equipment of ports, and tendencies for the future, by Mr. C. Foin, Chief of the Service of Port Equipment. The high production standard of Travaux direction is maintained in this large volume; it is profusely illustrated, and many ingenious devices and advanced techniques are explained with clarity. The following brief examples are typical of the operations in this great organised scheme of resuscitation of the ports of France.

PORT OF ST. MALO-SERVAN

The historic port of St. Malo-Servan passed through the war period suffering no serious damage until towards the end. Before abandoning the city, the Germans, who had for months been engaged in mining the main structures of the harbour, wrecked the installations. It is not a great commercial port but, nevertheless, it has for centuries been an important one, and Mr. R. Mitault, the Civil Engineer in Chief (I. & V.), does well to call attention to this fact. The most difficult problem the engineers had to face was the reconstruction of the destroyed entrance locks and dry dock. The latter was sandwiched between the small and the large locking chambers in the narrow strip of land separating the outer harbour from the Vauban wet dock. To appreciate the task, one must be mindful of the high tidal range of 43 feet, and the possibility of occurrence of waves of 2 metres amplitude, in the outer harbour, during severe westerly gales.

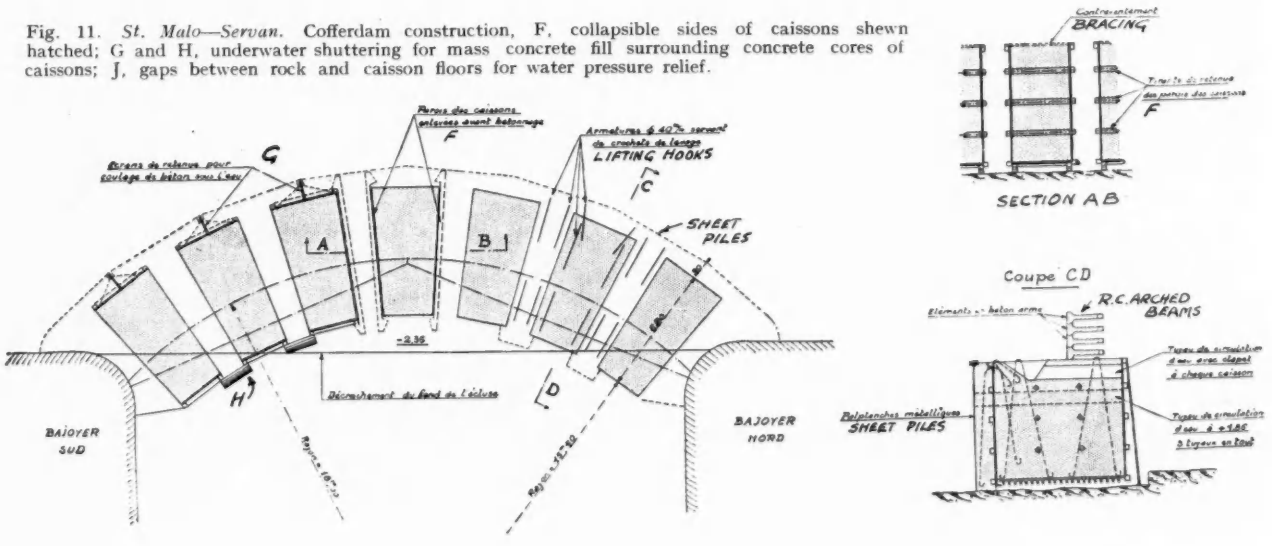
One of the first undertakings to put the wet docks into service again was the sealing of the Vauban basin ends of the two entrance locks, and the transformation of the dry dock between them into an entrance lock. In his article dealing with this, Mr. J. Velut recounts many of the technical and economic considerations adumbrated prior to a definite decision on the final form of repair; indeed, when the problem was resolved, another closer investigation of the large entrance lock showed that the gate abutments at the harbour end were bodily displaced, the south head by 0.15 m. and the north head by 0.40 m. towards the harbour, and no less than 1.25 m. closer together, the gate grooves remaining almost plumb. Thus there then arose a further extension of the reconstruction, and the problem of a suitable form of cofferdam to seal the sea-end entrance.

Envisaging the shortage of materials, the design eventually approved was ingenious and effective. It took the form of a lower structure 5.50 m. high and 6.50 m. wide of a self stable, or gravity wall, in the form of an arch with an outer radius of 22 m. and an inner radius of 15.50 m. (Fig. 11). A wall of single steel sheet piling was driven around the outer perimeter, seven timber box caissons about 3 m. wide were built with collapsible sides, and a keelson on each, of heavy baulk timber running round three edges of the base, as shown in cross sections. The floor of the caisson was substantially constructed to support the weight of concrete required for buoyant stability to float to site. For ease of handling by floating crane, four steel bar hairpin hooks were cast in the concrete. The rock formation was levelled by divers and the units were placed in the positions as shown hatched in plan. They were then filled up with concrete. When this had set, the caisson sides were stripped and the space then left between the sheet piling and the isolated concrete blocks was filled with concrete. Shuttering was placed at the intrados over the gaps between blocks.

There resulted a solid arched mass of concrete between the two entrance heads, excepting for the spaces at the bases of the caisson blocks where the floor timber remained. The reason for this gap was to relieve the upward hydraulic pressure through the rock fissures over as great an area as possible. Another precaution was to provide, in the tops of each caisson, pipes furnished with clack

Travaux. The French technical review of Public Works and Reinforced Concrete. No. 189, July 1950.

Fig. 11. *St. Malo—Servan.* Cofferdam construction, F, collapsible sides of caissons shewn hatched; G and H, underwater shuttering for mass concrete fill surrounding concrete cores of caissons; J, gaps between rock and caisson floors for water pressure relief.



The Maritime Ports of France—continued

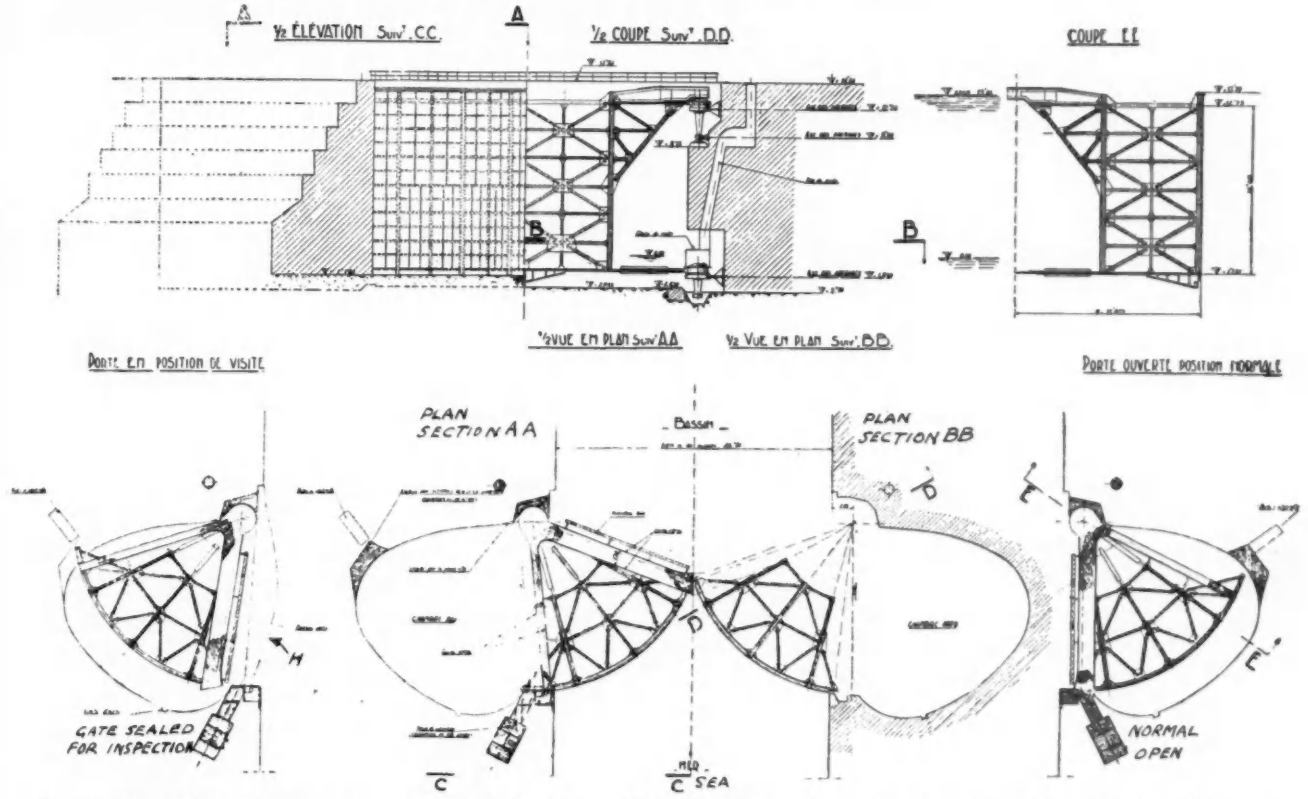


Fig. 12. *St. Malo.* Entrance gate quadrants to lock. H, special floating caisson gate to seal sector gate in side chamber for painting, etc.

valves to allow water circulation from one side to the other of cofferdam, as shown in cross section C.D. Above this self-stable sub-structure, pre-cast reinforced concrete elements of T section and bow shaped in plan, with the outer face cast to a radius of 18 m., were built up in the manner shown. After the sealing and grouting of the joints, the cofferdam proved to be almost water-tight. The daily pumping demand was 10,000 cubic metres, the great bulk of which passed through the shattered masonry of the walls.

In view of the large amount of work required to be done to refit the gates as they originally existed, it was decided that it would be more economical to replace them by sector gates of 16 metres height. Such gates are not subject to the inconveniences of mitred gates, or the floating caisson-gates. This new arrangement entailed considerable work at the entrance heads for the large recesses required, as shown in plan (Fig. 12). When the gate is fully withdrawn, a specially built floating caisson can be placed across the mouth of the recess, which can then be pumped out and the gate inspected, or repainted, in place, as shown to the left. The part plan to the right shows a leaf of the gate in the normal open position. The centre plan shows the gate closed.

The mechanical design of the slinging of the gate leaves is ingenious. To avoid jamming, the upper and the lower pintle bearings are articulated. The pin for the upper hinge is almost 10 feet long, with a large diameter head held in a substantial bearing bracket anchored back into the concrete wall, and at the foot it rests on a hard steel spherical nose and bearing plate, also held in a bushed bearing bracket anchored to the wall. The upper bearing is bushed with an eccentric ring to allow of adjustment of plumb between the two gates. The lower support does not have this adjustment, but is held at the base in a spherical self-aligning bearing. Inspection access to the lower support is provided for by the shaft through the concrete abutment shown at section DD. The watertightness is arranged for by a thick strip of rubber secured to one side of a long thin metal box. Applying, or releasing, pressure on the inside of the box forces the rubber against, or pulls it away from, the abutment.

PORT OF BREST

The main items of reconstruction at the Port of Brest were the walls of the large dry dock, and the isolated mole fronting the harbour. The damage to the dry dock walls was mainly localized in the faces and the upper portions, the foundations and floor were in good condition. They were therefore rebuilt to the original section by pinning the new facing to the sound part of the existing walls. The original dock was 750 feet long and 90 feet wide. It has been divided into two chambers by the construction of a central gate and sill. Messrs. R. le Port and M. Piquemal contribute a complete description of the port activities and show that the greater part of the damage has been successfully repaired.

THE FISHING HARBOURS OF FINISTERRE

Small though fishing harbours may be, they contribute a goodly part of the social economy of a maritime country and frequently represent a very important part of the commercial activities of coastal regions. This is particularly so in the Finisterre department of Brittany. There are about a dozen of small harbours here showing a considerable upward trend of traffic, and in all of them there is an expansion of facilities and security. One most interesting feature is the popularity of a type of breakwater called Considère, named after the well known reinforced concrete pioneer, who at one time was engineer-in-chief of the district. Apparently he evolved the design about 1890, and with modifications it is still in use to-day. Mr. P. Bastard gives a brief and authoritative account of several of the newer constructions.

At Penmarch there is one almost completed (Fig. 13). The top width is 2 m. at a level of + 7.50 m. with side slopes of 2 in 1 resting on a rubble base at level + 2.50 m. The rubble

The Maritime Ports of France—continued

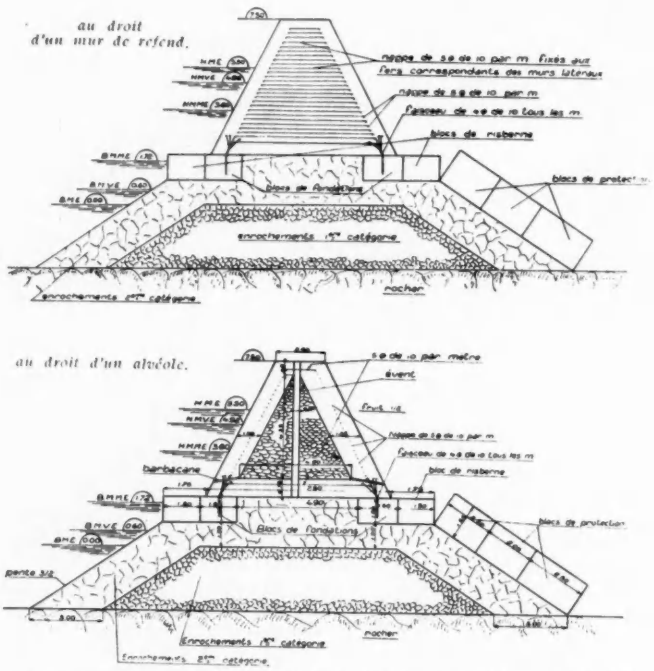


Fig. 13. *Penmarch.* Considère type breakwater with core of dry stone, showing reinforcement in concrete bulkheads and walls. Barbacane — drain. Event — vent. Nappe — reinforcement grouping. Risberme—apron.

lies on rock at level – 6.0 m. The fundamentals of the design as originally constructed in Considère's time were a triangular cross section with masonry walls 1 m. thick, with bulkheads or transverse walls at varied spacings. These masonry walls were reinforced with flat iron bars, and the space between the walls filled with dry rubble. The new type is of reinforced concrete with bulkheads spaced 5 m. apart. Every 30 m. or so there is a narrow gap left between two adjacent bulkheads as an expansion joint. If the wall is built on rubble, then a reinforced concrete base is added to prevent internal aspiration. This is relieved from the rubble bank by a vertical vent 9 to 12 inches diameter through each cellular compartment. Mr. Bastard very definitely expresses the opinion that walls of this type must be provided with drainage holes at the base of each cell to permit the evacuation of water as the tide falls, and it is also imperative to provide vents to avoid internal hydraulic pressures from water movement.

He has also found, from experience, that reinforced concrete proves more satisfactory than reinforced masonry. The present practice is to make the offing wall 1.2 m. thick and the harbour wall 1.0 m. thick. It is claimed for these dry filled R.C. walls that they are more supple and less liable to damage from sea action than solid walls. Mr. Bastard points out that some walls constructed without vents and drainage have failed, and that on examination afterwards it was found the internal dry rubble fill had been rounded like wave worn shingle by the infiltration of water through fissures in the rock, joints of the masonry, or through rubble base not sealed off from the cellular wall. In others in which the fill had been of small material, it was found to be depleted by having been drawn out at the base of wall.

PORTS OF NANTES AND SAINT-NAZAIRE

The informative and concise manner in which Mr. R. Gibert, Director of the Ports of Nantes and Saint-Nazaire, with whom Mr. J. Bontron collaborates, expresses his arguments on the new construction of the quays in these important harbours carries conviction. The new designs are neat, simple, and sturdy. They have found it economical, in most cases, to dispense with bracing and to drive the supporting R.C. piles in groups linked by a saddle beam or heavy slab upon which pre-cast tee beams were laid to form a platform. On this platform, a 2 metre depth of fill was laid. The pile groups at the outside edge of the quay were boxed in with concrete (Fig. 14) with the unusual feature of a cut-away bottom edge parallel with the rubble slope, as shown. The positions of the old piles of the destroyed quay are shown dotted. It is the practice at Nantes to anchor back the quay decks by substantial tie-bars.

PORT OF BORDEAUX

The Port of Bordeaux, 100 kilometres from the mouth of the River Gironde, was accessible to vessels drawing 8.30 m. at all high tides, and the advance ports of Pauillac and Verdon Pier to vessels of greater draught. At the time of the Liberation, there were no less than 200 sunken vessels encumbering the river and quays, and at least 33 per cent. of the harbour installations were destroyed. The advance ports were demolished, including the important trans-atlantic calling station and quay of Verdon.

Only recently was it possible to acquire a full pre-war dredging complement, including the well-known salvaged and repaired suction dredger, " Pierre Lafort." Mr. A. Grange, the Director of the port, opines that a suction dredger is by far the most suitable type to preserve a long channel such as the River Gironde. The test of a small suction dredger in the Bec d'Ambes region, one of the most difficult channels, gave extremely good results and confirmed that the maintenance of a long channel is best undertaken by a travelling suction dredger rather than with a bucket dredger. With the former there is immediate improvement. In the troublesome sectors, where the deposits are considerable, the duration during several weeks of the forward cut of a bucket

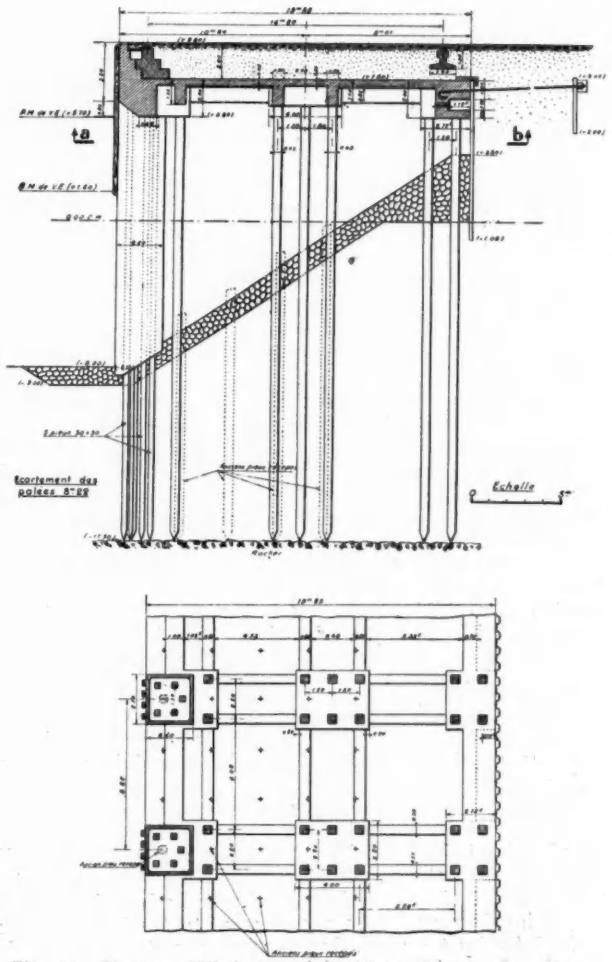


Fig. 14. *Nantes.* Wilson quay. Positions of old pile stumps are shown dotted.

The Maritime Ports of France—continued

dredger causes downstream deposits, so that when the upstream stretch is completed the results obtained are somewhat nullified. On the other hand, the long furrows made by the suction dredger directs and assists the scouring action of the current. For this reason, the Bordeaux bucket dredgers are reserved for use alongside quays and wharves.

The present programme is to improve the channel to allow access to Bordeaux of all vessels up to 8.50 m. draught, and of vessels of 10 m. draught at Pauillac.

To make full and more economical use of the Bordeaux ports at all times, the authorities are installing a more elaborate system of navigational lights and aids, radio-electric being included. So far, the latter has been subject to local interference and is not yet at its best.

A rather good example of the sturdy simplicity of design favoured by the Bordeaux Authority is shown in Fig. 15 of a dolphin for the tanker berth at d'Ambes. The S.I.M.E.C. pendular fenders are omitted from the illustration, which shows the trunnion pedestal from which they are suspended, and the chamber in which the adjustable dash pot shock absorbing apparatus is installed.

THE BASQUE PORTS

The basque coast, where the River Adour debouches into the Bay of Biscay, is that part of France, and of Europe, which is most exposed to the full wave force of Atlantic westerly gales, in spite of being screened from the south-west by the coast of Spain. The mouth of the River Adour is only 45 kilometres from the bathymetric line of 100 fathoms depth, which is known as the continental edge. In these ocean depths the maximum size of Atlantic waves preserve their full energy and character and lose only a fraction of this in traversing the short and steep slope of the continental shelf to the Adour River, where waves of 9 m. height and 400 m. long, with periods of 18 seconds, assail the breakwaters. The Port of Bayonne lies 12 kilometres up the river from the entrance piers. It has therefore been the practice to protect the masonry breakwaters, which run almost parallel out to sea, with heavy pell-mell blocks for a width of 30 m. from the sea faces. No Titan crane or floating crane was available for this dumping, and Mr. G. Dreyfus had recourse to improvisation. An old L.C.T. (Fig. 16) was fitted out with rollers and link conveyors in the bottom of the hold and over the inside of the bow door. It was possible to load the craft with twelve 15-ton blocks in line down the centre line of the hold. In suitable weather, the craft then dumped them one by one in the required positions. This work was usually accomplished in one hour. The method has proved exceedingly successful and it is recommended as most efficient and economical. It is the intention, when the new blocks have found a stable position, to eventually pour bitumen over the slope to prevent grinding and spalling under wave action.

Fig. 16. *Bayonne.* River l'Adour. Converted L.C.M. placing blocks against breakwater.

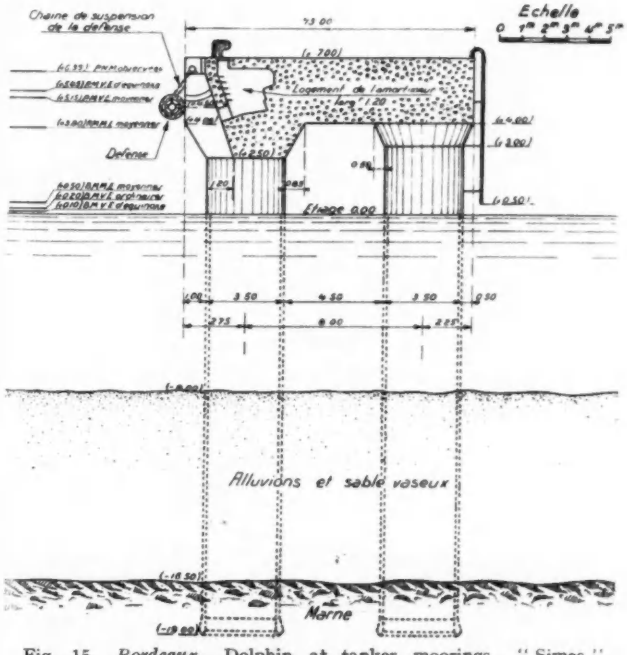


Fig 15. *Bordeaux.* Dolphin at tanker moorings. "Simec" articulated dash pot fenders omitted. Temporary brushwood fender is slung from trunnions of pendular fender.

THE PORT OF SETE

Not unlike most ports during the war period, the want of regular dredging increased the silting problems of the port of Sète. Mr. Ph. Deymie, the Engineer-in-Chief, was thus confronted with a heavy programme; a deposit representing almost 4 years' work of the pre-war dredging average encumbered his harbour; all his dredgers and hoppers were sunk, and the port shattered by bombardments and dynamiting. The main pre-war traffic of the port was the coming and going of the large oil tankers, serving the large refineries on the borders of the town. Owing to the increase in size of the present day tankers, and the yet further increases of size of new construction, there was not sufficient depth of water in the old berth of the outer harbour to deal with the traffic. From the old berth to the refineries there was a pipe line 7 kilometres long. Since it was urgent that the traffic should be renewed, it was decided that a pipe line laid out to sea to some suitable anchorage would be the most effective and rapid solution.

A site was eventually chosen and the alignment of the pipe line agreed. It ran from the beach over a depth of sand varying from 0.40 m. to 4.00 m. in 14 m. depth of water at the anchorage. The method of laying the pipe was simple. A narrow gauge track was laid with a loop line at the sea end, the line of the track coincided with the pipe alignment. Alongside the track, and at the height of the bogies platform, timber supports were erected, upon which part of the pipe line could be mounted and welded together. The total length from the beach was 2,600 m. The pipes were in 10 m. lengths, 12 inches diameter, and each weighed one ton. On the timber supports, a length of 1,140 m. was first welded, and a second length of 1,525 m. was welded together on the bogies marshalled on the track immediately alongside. To the sea-end extremity of the latter, a Y-piece with 8 inch diameter branches was firmly welded. Immediately behind the Y-piece a loaded bluff ended wooden plough was secured to prevent twisting and to scoop out a trench through the sand to bury the pipe line.

A large tanker equipped with powerful winches and anchored out at sea in alignment with the pipe line then hauled the longer length resting on the bogies. As each supporting bogie reached the terminus of the track, it was hauled clear and placed on the return loop. When the shore end of the hauled length reached the position of the sea-end of the pipe length on the supports, hauling was halted. This second length was then rolled on the bogies, which had by then been placed alongside on the main track. The two ends of each pipe length were then butted and

The Maritime Ports of France—continued

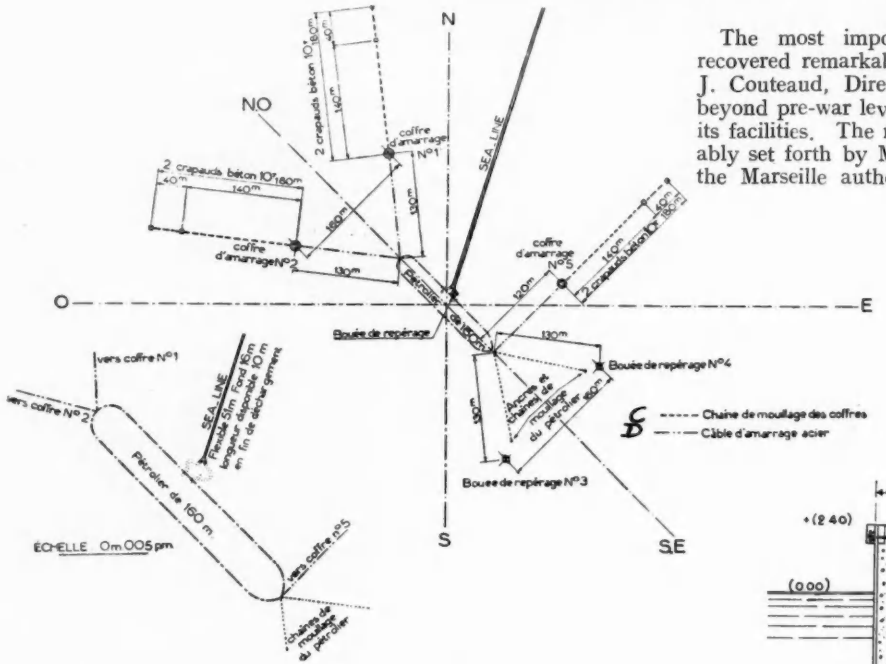


Fig. 17 (left). *Sète.* Moorings of tankers discharging oil by sea pipe line. C—anchor chain to buoys. D—steel mooring cable.

welded. After trimming the butt weld, a sleeve 1 m. long was placed over it and welded in place. Hauling was again recommenced. The launching operation took one day only.

The moorings for the vessels were arranged as shown in Fig. 17. Three mooring buoys, numbered 1, 2 and 5, of 3.50 m. diameter, were each secured by chain to two 10-ton concrete blocks buried in the sand. They are placed in a triangular pattern with fixed lengths of cable securing the vessel, so as to register the ship in the correct position for picking up the 50 m. long flexible pipings connected to the Y-piece. These normally lie on the sea bed. Two marking buoys, numbered 3 and 4, at the bows of the tanker, show the positions where the vessel must drop her anchors.

The reconstruction work on the quays, breakwaters, and equipment of the harbour is more than 60 per cent. completed.

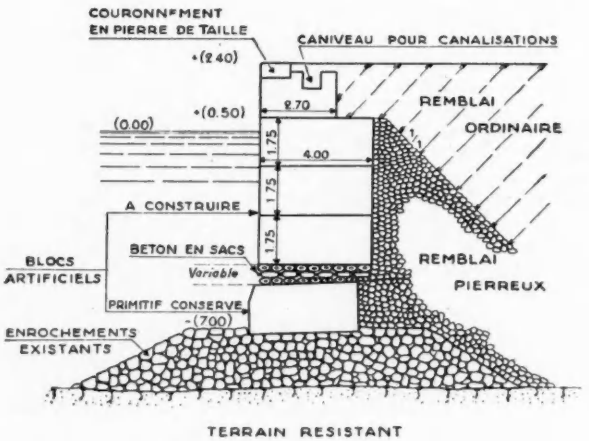


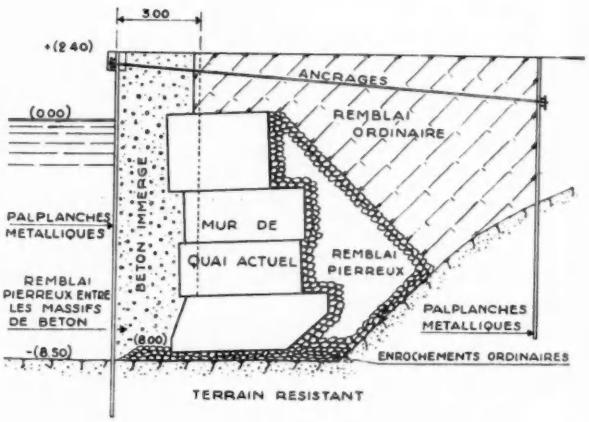
Fig. 18 (above). *Marseille.* Repair of breaches in quay when base blocks were not dislocated from line but were tilted. Beton en sac—concrete bagging.

Fig. 20 (right). *Marseille.* Newly founded quay in front of old dislocated quay. Additional rubble foundations at toe of heavier grading than original mound. Bottom dredged of mud and part of original high rubble mound. Wall is battered (fruit) to allow for toe settlement.

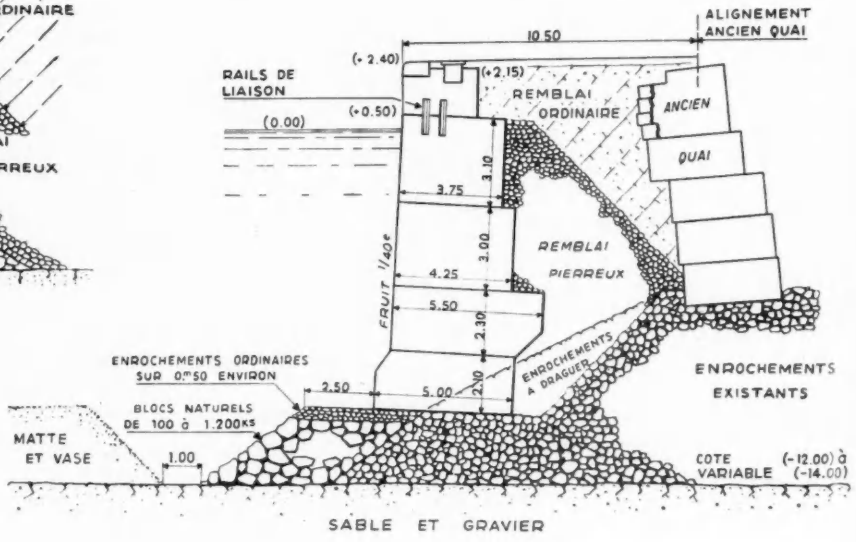
THE PORT OF MARSEILLE

The most important Mediterranean port of Marseille has recovered remarkably quickly from its war wounds, and as Mr. J. Couteaud, Director of the Port, points out, is forging ahead beyond pre-war levels and yet further developing the harbour and its facilities. The methods of reconstruction of the quays, etc., is ably set forth by Mr. P. Vey. It becomes quickly apparent that the Marseille authorities have developed a special technique of

Fig. 19 (below) *Marseille.* Repair to secondary quays not subject to heavy loading, where original blocks are dislocated.



repair and reconstruction, a type of resourceful make-do which gives the impression of a breathless energy to get the job finished. For example, where the footing blocks of solid quay walls are still in line but settled at the toe, and unbroken (Fig. 18), the part of the wall above is dismantled and layers of bagged concrete placed on the tilted surface to a maximum thickness of 0.50 m., so as to obtain a horizontal bed for the new pre-cast blocks of the superstructure. For quays of secondary importance, where the blocks were displaced and tilted (Fig. 19), a single wall of sheet piling



The Maritime Ports of France—continued

was driven 3 m. in front of the old alignment and anchored back to sheet piles in the rear. The space between this wall and the damaged block wall was then filled with concrete. For those quays where conditions required new foundations, such as shown in Fig. 20, the technique of proportions, height of rubble mounds, widths of berms, and the batter to the wall face to allow for settlement of the newly stressed ground at the toe, had all been considered and fixed. Whilst at first sight several of the Marseille authority's methods as, for example, leaving the unstable ruins in place, would not receive commendation here, it should be borne in mind that there is no tidal range in Marseille. One recalls the case of the tilting of the Chanzy quay at Boulogne that required, eventually, the demolition of the old Buonaparte quay behind it and costly new deck work.

The remarkable feature about French maritime engineering method, so ably described in the two monumental issues of "Travaux," is the boldness of the solutions to problems and the energy of execution, despite the fact that quite a lot of temporary work is done in a manner contrary to British practice. We are inclined to make temporary structures almost as substantial as the main works, whereas French engineers, craftsmen and workmen, are experts in expediency and have complete confidence in their methods—moreover, they succeed. The inside of a French cofferdam is often a maze of natural timbers, and the stranger is inclined to the view that the work must be hampered thereby. The extraordinary thing is that it is not. It seems to be a necessary accompaniment for the sweet working of the operations. Accidents do happen. They also happen in more orderly dispositions. When all is considered, the French practice in this respect is less costly and more expeditious.

The main point that emerges from these two volumes is the great advantage that derives from the study of the practice, and the methods, of other nations, among which the French are second to none in ingenuity and resource.

ERRATA.

October issue, page 195, sub-heading Port of Calais, line 13, should read: " . . . 505 feet . . . at the outer sill " not 550; page 196, Port of Boulogne, 2nd col., line 9, should read: " . . . at low water it was less than . . . " not more.

The actual condition was the settlement (which is negative) increased on a rising tide and decreased on a falling tide with a slight lag after the maximum and minimum water levels.

Siltation Research by P.L.A.

Hydraulic Model of the River Thames

Further details have now been published by the Port of London Authority concerning the problem of siltation on the River Thames. The Port Authority, as Conservators of the tidal reaches of the River, are responsible for maintaining a sufficient depth to meet the requirements of shipping, and as certain reaches of the River are subject to continuous silting, the depth is only maintained by constant dredging, which involves the Authority in the expenditure of about £500,000 per annum.

For some time past, the Authority have been investigating the question of siltation with a view to ensuring that the methods employed in maintaining the navigable depths are the most efficient and economical possible. The investigation is being carried out under the direction of Sir Claude Inglis, C.I.E., Director of Hydraulic Research of the Department of Scientific and Industrial Research.

The consideration of certain aspects of the problems will be assisted by a hydraulic model of the Thames, which is planned to have a horizontal scale of 1:600 and a vertical scale of 1:120. To obtain information required for the construction of this model, a Pilot Model has been constructed, and experiments are being made to determine the most suitable location and orientation for the tide generator in the large model. Although it should be emphasised that the Pilot Model has not been designed to solve directly the siltation problems, the solution of which is the object of the investigation, it is probable that much useful information may be obtained about the flow patterns and bed movements in the River as it was before any dredging has been done, and so enable valuable comparison to be made with the characteristics of flow at the present time. At a later date, experiments may be made in the Pilot Model to observe the effects of dredging.

DETAILS OF PILOT MODEL

The Pilot Model has a Horizontal Linear Scale of 1:3000 and a Vertical Linear Scale of 1:120. The Time Scale is 1:273.8 so that the tidal period of 12 hours 25 minutes will therefore be reproduced in 2 minutes 43 seconds.

Tide Generation will be by means of reduced air pressure created by a turbo-exhauster in a pneumatic displacer. The tides to be reproduced are drawn on a roll of paper in the form of a black and white graph; this graph is scanned by an electronic follower which controls the air pressure in the displacer and hence the water level in the model. (The electronic apparatus was designed and constructed by the Hydraulic Research Organisation, D.S.I.R., at the National Physical Laboratory.)

The model has been moulded to reproduce the river as it was in 1830-34 when it was surveyed by Commander Bullock, R.N. Where the slopes are of 35 degrees or less, the moulding of the Thames has been done in washed quartz sand with a mean diameter of 0.17 mm. Where the slopes exceed 35 degrees, cement mortar has been used.

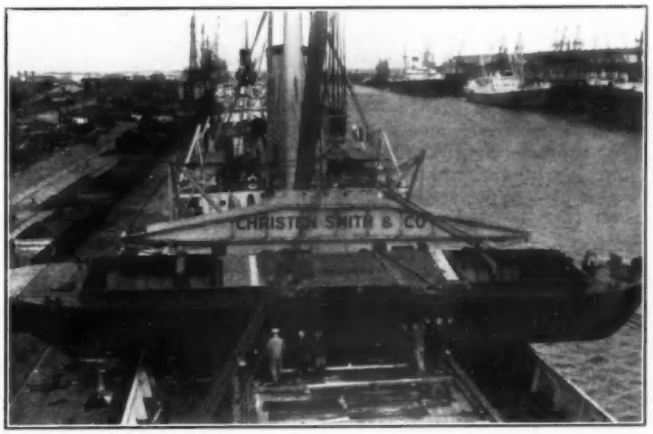
The River Medway has been moulded entirely in cement mortar as it is reported that only minor changes have occurred there in the past century. These changes have no bearing on the investigation and would not have materially affected the flow pattern of the Thames.

The Seaward Limit is approximately that of the limit of the Port of London Authority; exactly on a line passing through the Nore, joining Havengore Point in Essex and Hens Brook (near Eastchurch) in Kent. The estuary at this section is about 10 miles in width.

The Upstream Limit is Blackfriars Bridge ; the tidal prism between Blackfriars Bridge and the tidal limit at Teddington Lock being accommodated in a labyrinth.

The River Medway is moulded upstream as far as Rochester, and a labyrinth contains the tidal prism between this section and the tidal limit at Allington Lock.

BARGES FOR BENGHAZI



An interesting export cargo was seen at the Royal Edward Dock, Avonmouth, on 14th October, when six swim-ended steel barges, which had been towed down the River Avon from a Bristol shipyard to Avonmouth, were loaded on the "Belray." Built to Lloyds class and survey by Messrs. Charles Hill & Sons, Ltd., Bristol, four of the barges weighed about 35 tons and two about 27 tons. The order was placed by the Crown Agents for the Colonies and the barges are for service at Benghazi Harbour.

Book Review

" Canals, Barges and People." Text and engravings by John O'Connor. Published by Art & Technics, London. Price 10s. 6d. net.

This slim volume is chiefly remarkable for the high artistic standard of the Author's wood-arts and lino-cuts. The Publishers and the Artist are to be congratulated for their co-operative endeavour, the result of which is that the illustrations are equal in quality and value to those expected in a limited edition. The production is certainly a triumph in this respect, while the illustrations—almost exclusively of narrow boats, despite the title—capture the sense of decorative colour of the traditional narrow canal boat.

Although the book cannot be regarded as an authoritative work, and doubtless is not so intended, any book which draws public attention to Inland Waterways fulfills some function in the interests of the Waterways Industry. However, it is always a cause for regret when a book of this type contains mis-statements which could surely have been avoided by consultation with an authority, and this impression is aggravated when the book is written in such a way as to imply to the un-informed that it is written by an expert. For example, the frontispiece is entitled " Locking on the Oxford Canal," but illustrates a wide lock of the Grand Junction type, with the unexpected feature of bottom gates which close the wrong way.

The Author would be well-advised to avoid technical terms in a popular work, since there is so much risk of their being ineptly applied. One illustration is entitled " Butty boat with ' rams head ' cord on tiller "; another shows a " Motor-boat with storm fender." Neither title has meant anything to any boat captain to whom these have been shown although the latter presumably means " stern fender." Finally the sketch map contains so many errors, that it is most misleading.

However, the Author writes with affection and a genuine interest in canals, and he succeeds in conjuring up a picture in the mind of the reader, which no amount of precision, alone, would have achieved.

A. L. H. B.

Publications Received

Report on Ships' Navigational Aids.

Existing arrangements for ships' navigational aids, other than radio, have been reviewed by members of a Working Party set up by the Minister of Transport, and their Report, which has now been issued, makes recommendations concerning ships' compasses, depth-sounding devices, and the lighting of chart rooms.

The Working Party consisted of members drawn from the Ministry of Transport, the Admiralty, and organisations of shipowners' ships' officers and men, and the nautical instrument trade, and was set up in 1946, but its work was interrupted by the 1948 International Conference on Safety of Life at Sea.

In recommending that the Minister should issue Notices about compasses to shipowners, shipmasters and shipbuilders, the Report aims at producing a code of good practice which will be acceptable to all the interests affected. This code leaves ample room for progress in design, for competitive variety, and for improved methods.

One of the proposed Notices sets out the minimum standards to which the provision and maintenance of compasses in sea-going ships should conform. These standards have been agreed with all the interests affected and are in fact already the practice among shipowners today. For example, it is proposed that all new sea-going ships should have at least two magnetic compasses; that every new magnetic compass should, before installation, be tested at the Admiralty Compass Observatory; and that they should be sited so as to avoid interference by magnetic material. Even steel rings in officers' caps, it is pointed out, may affect compasses.

Perhaps the most notable achievement of the Working Party was to produce a standard specification covering the quality and performance of magnetic compasses. The need for such a specification has been felt for a long time and is a pre-requisite of the testing of compasses at the Admiralty Compass Observatory. The specification will be adopted as a British Standard by the British Standards Institution.

The Working Party recommends that all sea-going ships, both passenger and cargo, subject to a specified minimum tonnage limit, should carry one mechanical sounding device and two hand lead lines of 25 fathoms each, with leads of at least seven pounds.

Another recommendation is that in peace-time ships' chart rooms should be provided with orange lighting. Night vision, it is stated, is seriously, though temporarily, impaired by exposure of the eyes to white light, or to light of most colours, but it may be largely preserved in red light and to a lesser extent in orange light. There are, however, objections to red lighting which do not apply to orange. Admiralty charts, light lists, and other publications, are corrected in violet ink to enable them to be more easily read with orange lighting.

Books on Wood.

There are many hundreds of text books on the subject of wood, and the student or technician often has great difficulty in finding the particular work of reference he requires. It may be he is quite unaware that there is a particular book, covering his interest or problem, or perhaps he just wishes to obtain a particular work that is not on the booksellers' list.

To help to solve the problem the Timber Development Association has, during the past ten years, collected in its Headquarters' Library about one thousand three hundred of the most useful books on the growth, structure, properties and uses of wood. These have all been classified and catalogued, and are now available for reference purposes. To assist those who wish to know of or obtain a particular work the Association has recently issued an up-to-date catalogue in which all these books are listed under subjects with author's name, title and publisher. This grouping provides the reader with a choice of books under any given heading. For ease of reference an alphabetical index of subjects and authors' names has been included; one is therefore able to trace very easily the number of books an author has written and all the subjects covered, both of which refer back to the main body of the catalogue.

Copies of this new edition of the " Library Catalogue " can be obtained on application to the Timber Development Association, 75, Cannon Street, London, E.C.4.

The Analysis of Concretes.

The method employed at the Building Research Station and the Road Research Laboratory for making analysis of hardened concretes is described in National Building Studies Technical Paper No. 8, published last month for the Department of Scientific and Industrial Research by H.M. Stationery Office, price 9d. (25 cents U.S.A.), by post 10d.

The analysis aims at providing evidence of the nature of the constituent materials, and of the proportions in which they are present. The paper outlines the limitations of the method and gives fairly detailed working instructions for the sampling and analysis of a typical concrete. The description of the full procedure is followed by suggestions for simplification in certain cases, and by a discussion of the magnitude of the errors in the calculated composition.

This series of Technical Papers is written primarily for scientists, research workers and technical men and is not intended for the general reader or for those concerned with the practical everyday problems of the building industry.

Building Topics.

The latest issue of this attractive little Journal, the house organ of Tretol, Ltd., Manufacturers of Paints and Building Trade Products, contains an important article on mineral sulphates and their effects on concrete, a survey of the effects of mineral salts on underground concrete structures. Other features include a description of useful methods of protection and construction of flat roofs and parapets. Copies can be obtained free from Tretol, Ltd., 12/14, North End Road, London, N.W.11.

EXTENSIONS AT THE PORT OF SAVANNAH, U.S.A.

The Georgia Port Authority has received a $5,000,000 loan to expand port facilities at Savannah. Plans include a new 2,065-ft. pier and three transit sheds.